CIRC. 295

GEOLOGICAL SURVEY CIRCULAR 295

IRRIGATION-WELL DEVELOPMENT IN THE KANSAS RIVER BASIN OF EASTERN COLORADO

UNITED STATES DEPARTMENT OF THE INTERIOR
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GEOLOGICAL SURVEY
W. E. Wrather, Director

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By W. D. E. Cardwell

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IRRIGATION-WELL DEVELOPMENT IN THE KANSAS RIVER BASIN OF EASTERN COLORADO

By W. D. E. Cardwell

ABSTRACT

The Kansas River basin in eastern Colorado consists mainly of flat upland plains mantled in places by sand hills and dissected only by the valleys of the main streams. In this semiarid region, which has an average annual precipitation of about 17 inches, farming and the raising of livestock are the principal occupations. Irrigation, which has increased greatly since 1940, is practiced in several places in the region.

The exposed rocks in the region are of Cretaceous to Recent age. Much of the region is underlain by the Ogallala formation of Tertiary (Pliocene) age. The Sanborn formation of Pleistocene and Recent(?) age overlies the Ogallala formation in the southeastern part of the region, and the Pierre shale of Cretaceous age, which underlies the Ogallala formation throughout the region, crops out in the more deeply incised valleys. Many parts of the upland area are underlain by dune sand, and the principal valleys are underlain by alluvium of Quaternary age. The Ogallala formation contains thick beds of sand and gravel, which yield quantities of water sufficient for irrigation in many places. The slope of the surface of the Pierre shale is about 33 feet per mile to the north-northeast.

The ground-water reservoir is recharged principally by precipitation that falls within the region and by percolation from intermittent streams and depressions. Ground water is discharged from the ground-water reservoir by movement into adjacent areas to the east and southeast, by evaporation and transpiration in areas of shallow water table, by seepage into perennial streams, and by wells. All water used for domestic, stock, public, and industrial purposes and most of the water for irrigation is obtained from wells.

Most of the wells in the area are drilled. In 1950, 66 of the wells supplied water to irrigate 5,760 acres. The areas most favorable for the development of irrigation are southeast of Holyoke, Phillips County; southeast of Burlington, Kit Carson County; and the valley of the Arikaree River in the vicinity of Cope, Washington County.

The ground water from the Ogallala formation is moderately hard but is suitable for most uses. Water from the alluvium of Recent age generally is much harder.

The field data upon which most of this report is based are given in tables, which include records of 178 wells and a compilation of data on irrigation wells. Logs of 329 test holes, water wells, and seismograph shot holes are included in the report.

INTRODUCTION

Purpose of the investigation

This investigation was begun by the United States Geological Survey at the request of the United States Bureau of Reclamation as a part of the program of the Interior Department for development of the Missouri River basin. The investigation was endorsed also by the Colorado State Water Conservation Board.

Ground water is one of the important natural resources of eastern Colorado, and each year more irrigation wells are constructed for its further utilization. Irrigation wells are concentrated locally in widely separated areas; significantly, however, individual wells of large yield are scattered between the areas of concentration. (See pl. 1.)

The pumping of ground water for irrigation in this area is increasing rapidly. Although pumping at the present rate probably would not result in a significant regional lowering of the water table, pumping at a doubled or trebled rate, which is not improbable, would cause both a lowering of the water table and a reduction in the base flow of perennial streams. A lowering of the water table probably would result also in greater infiltration to the ground-water reservoir of flood waters in the upper reaches of intermittently flowing streams. Although this recharge might not materially increase yields from wells in eastern Colorado, it probably would reduce appreciably the direct stream discharge into the surface reservoirs that have been built by the Bureau of Reclamation on the lower reaches of these streams.

All known irrigation and public-supply wells in the area were inventoried during this investigation and the resulting data have been tabulated. This information will be useful in the planning of new irrigation wells and as a basis for comparison when the effects of the additional pumping are known. Areas in which pumping of ground water for irrigation is feasible and areas in which it is not feasible have been delineated.

Location and extent of region

The region includes all the Kansas River basin in Colorado. It extends southward from the South Platte Valley to Cheyenne Wells and westward from the Colorado State line to Fleming in the north and Genoa in the south. (See fig. 1.) It includes all of Kit Carson, Yuma, and Phillips Counties and parts of Cheyenne, Elbert, Lincoln, Logan, Sedgwick, and Washington Counties. The region, which is about 150 miles north and south and averaging about 60 miles east and west, contains about 9,000 square miles.

Methods of investigation

The investigation was begun in July 1950 under the general supervision of A. N. Sayre, chief of the Ground Water Branch of the U. S. Geological Survey, and of G. H. Taylor, regional engineer in charge of the ground-water investigations in the Missouri River basin, and under the immediate supervision of T. G. McLaughlin, acting district geologist, Denver, Colo. The field work was completed in December 1950.

Measurements of the water level in 22 wells scattered throughout the region were made monthly. Most of the observation wells are in the areas of greatest concentration of irrigation wells.

Of the 178 wells included in the inventory, 121 are or are to be irrigation wells, 41 are public supply wells, 12 are abandoned domestic or stock wells used as water-level observation wells, 3 are stock wells and 1 is a cemetery well. (See table 1.) When possible, the total depth of the well and the depth to the static water level were measured using a steel tape; the total depth and the depth to the static water level in other wells were reported by the well owner or driller.

The discharge of 21 irrigation wells was measured using a Hoff current meter. Well owners and drillers reported the character

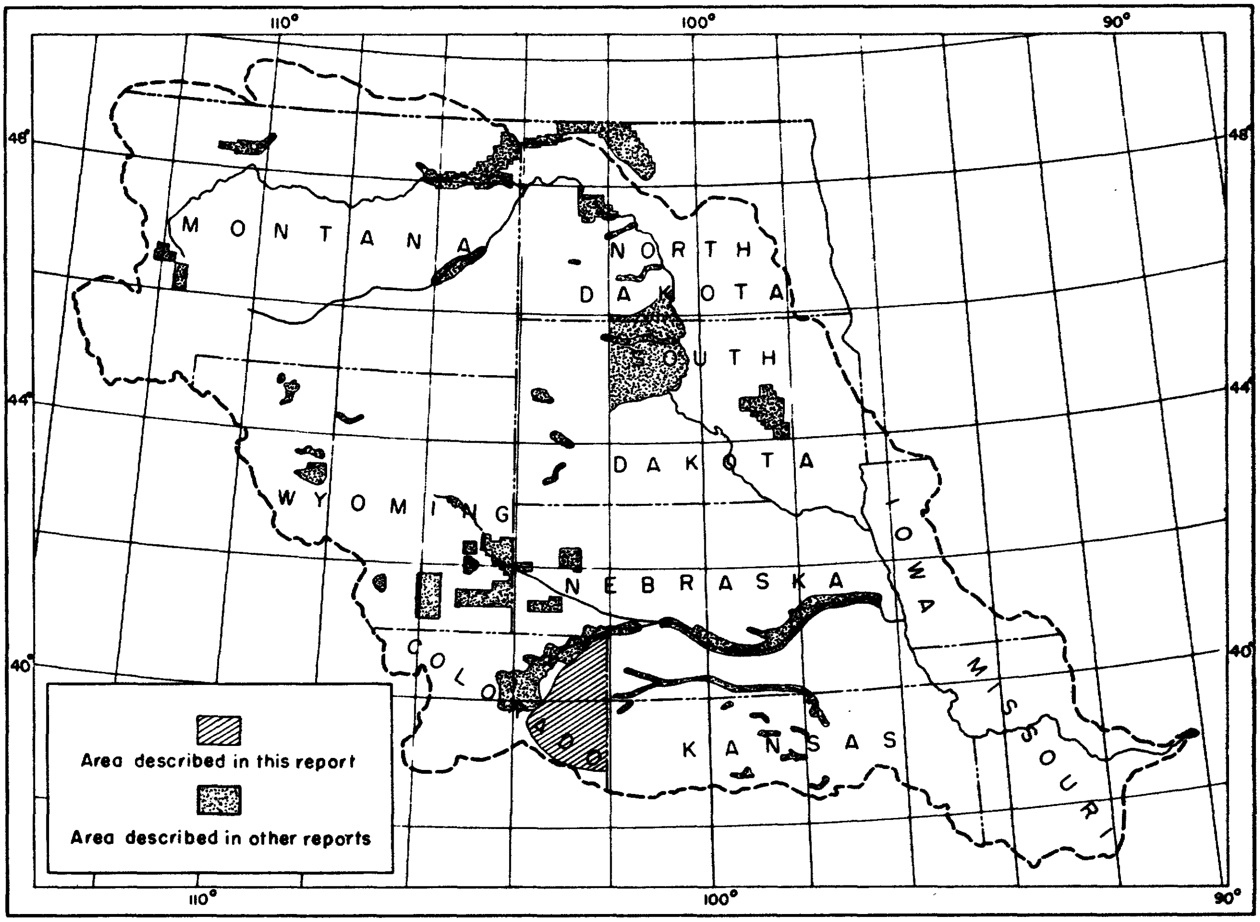


Figure 1. Map of the Missouri River basin showing areas in which ground-water studies have been made under the program for the development of the Missouri River basin.

and thickness of water-bearing formations, methods of well construction, type of pumping plants, irrigation methods, irrigated acreages, and other pertinent data. Well locations were determined by odometer measurements or by pacing from section corners.

All available well logs were collected from owners of irrigation wells, well drillers, municipalities, railroads, and oil companies. Many logs of test holes and of seismograph shot holes penetrating to the Pierre shale were compiled. (See table 2.)

Well-numbering system

Well numbers appearing in this report are based on the system of land subdivision of the Bureau of Land Management. The well number shows the location of the well by township, range, section, and position within the section. The first letter (capital) of a well number gives the quadrant of the meridian and baseline system in which the well is located; the letters begin with A in the northeast quadrant and proceed counterclockwise. All wells in this area lie in the northwest (B) or southwest (C) quadrants of the sixth principal meridian and baseline system. The first numeral of a well number indicates the township, the second indicates the range, and the third indicates the section in which the well is located. The lowercased letters following the section number locate the well within the section. The first letter denotes the quarter section and the second letter denotes the quarter-quarter section. The letters are assigned in a counterclockwise direction beginning with (a) in the northeast quarter of the section or of the quarter-quarter section. For example, the well number B1-45-30bd indicates a location in the SE¼NW¼ sec. 30, T. 1 N., R. 45 W. Where more than one well is located in a quarter-quarter section, consecutive numbers beginning with 1 are added. A graphical illustration of this method of well numbering is shown in figure 2.

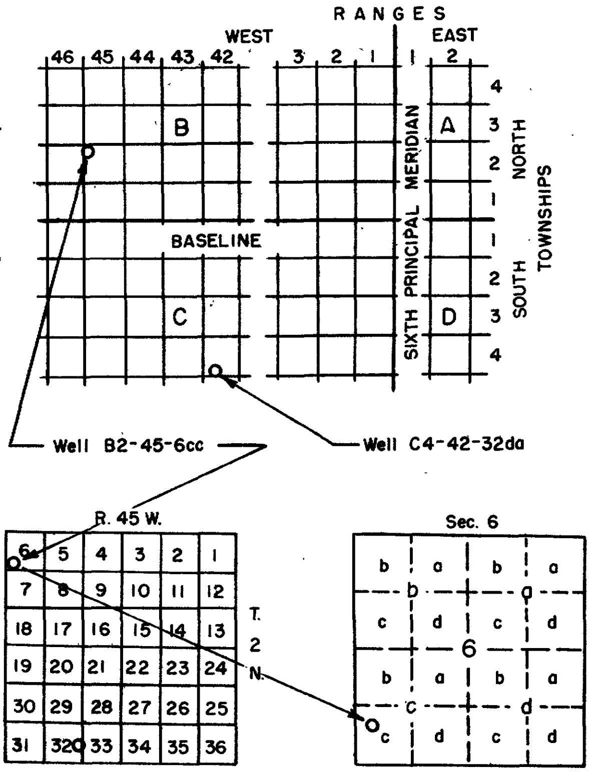


Figure 2.--Sketch showing well-numbering system.

Acknowledgments

Many well owners permitted the measurement of their wells, and town officials and residents supplied valuable information. Luther Wilkens, manager of the office of the Rural Electrification Administration in Akron, Colo., supplied information that greatly facilitated the investigation, and Byrle Miller and associates of the REA office in Holyoke, Colo., were cooperative and helpful. W. E. Code of the Colorado Agricultural Experiment Station at Fort Collins supplied many data that he had previously collected. Drilling contractors supplied well logs and other data; the Chicago, Burlington & Quincy Railroad Co. supplied logs of its wells and test holes; and oil companies supplied logs of seismograph shot holes and the altitude of the top of the Pierre shale in many of the shot holes and the altitude of the land surface at others.

GEOGRAPHY

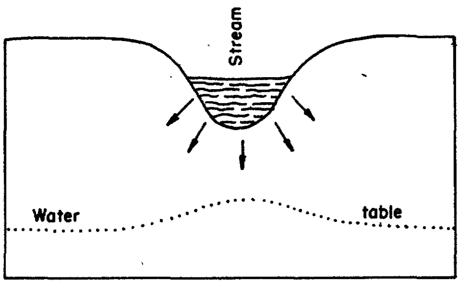
Topography and drainage

The investigated region lies entirely within the High Plains section of the Great Plains physiographic province. South of the Arikaree River the region is typically "short grass" country consisting of broad, flat areas, which in places grade into gently rolling upland divides that are dissected by narrow, shallow stream valleys. This area is dotted by undrained saucerlike depressions, which range in diameter from a few feet to a few thousands of feet. Their origin has been variously explained by Darton and others (1915, p. 36-37), Johnson (1901, p. 702-712), Hay (1895, p. 555-556), and Judson (1950, p. 253-273). Locally, the major streams have cut narrow, shallow canyons through the Tertiary strata into the underlying Pierre shale.

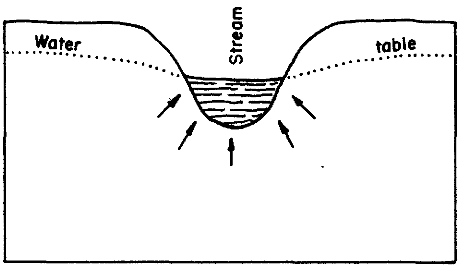
North of the Arikaree River the region is mantled extensively by dune sand. In general, the dune-sand area has a multicycle dune topography as described by Smith (1940, p. 164). In places of rejuvenation, secondary blowouts are common. Dunes in these areas are comparatively bare and probably are migrating to some extent. Elsewhere the dunes are in the youth to maturity stages of the eluvial phase of the sand-dune cycle and are protected by a vegetal cover sufficient to support numerous cattle. According to Wallace Bruce of the U. S. Conservation Service, soil in the dune-sand area ranges in thickness from a featheredge on the side slopes of the dunes to as much as 3 feet in the valleys between the dunes. Some of these interdune valleys are under cultivation. The interior drainage, which is typical of the eluvial phase of the sand-dune cycle, combined with the permeability of the dunes enables precipitation to percolate rapidly downward to the water table; losses by evaporation, transpiration, and runoff thus are reduced.

The entire upland plain slopes gently from west to east. The altitude of the land surface ranges from more than 5,000 feet above sea level in the west to slightly less than 4,000 feet in the east.

Ladder Creek, Smoky Hill River, North Fork of the Smoky Hill River, Landsman Creek, Spring Creek, South Fork of the Republican River, Arikaree River, North Fork of the Republican River, Red Willow Creek, Sandy Creek, Patent Creek, and Frenchman Creek head in the western part of the region and flow southeastward or eastward. Most of the streams flow only after relatively heavy rains; however, Landsman Creek, both forks of the Republican River, and the Arikaree River are perennial in their lower reaches where they have become effluent or gaining streams by cutting downward until their channels are below the water table. (See fig. 3.) Ground water moves along the eroded surface of the relatively impermeable Pierre shale and is discharged into these streams largely by seeps and springs. Flood waters in the intermittent water courses probably provide considerable recharge to the ground-water reservoir from loss of flow by percolation through the stream bed; streams of this type are called losing or influent streams. (See fig. 3.)



INFLUENT STREAM



EFFLUENT STREAM

Figure 3.--Diagrammatic sections showing the relationship of a stream to the water table.

Climate

The climate is the typically semiarid type of the High Plains and is characterized by little precipitation, high evaporation, low humidity, and much sunshine and wind. The summer days are hot and the nights are cool. The winters are relatively mild with occasional short periods of severe cold. The region is subject to blizzards in the fall and spring. Average annual temperatures at the stations of the United States Weather Bureau in the area are as follows: Akron, 48.5°F; Burlington, 49.2°F; Holyoke, 49.2°F; Julesburg, 49.5°F; Kit Carson, 51.1°F; Stratton, 51.6°F; Wray, 50.8°F; and Yuma, 49.0°F. The precipitation is greatest during the late spring and summer and is least during the winter. Precipitation graphs prepared from U. S. Weather Bureau records are shown in figure 4.

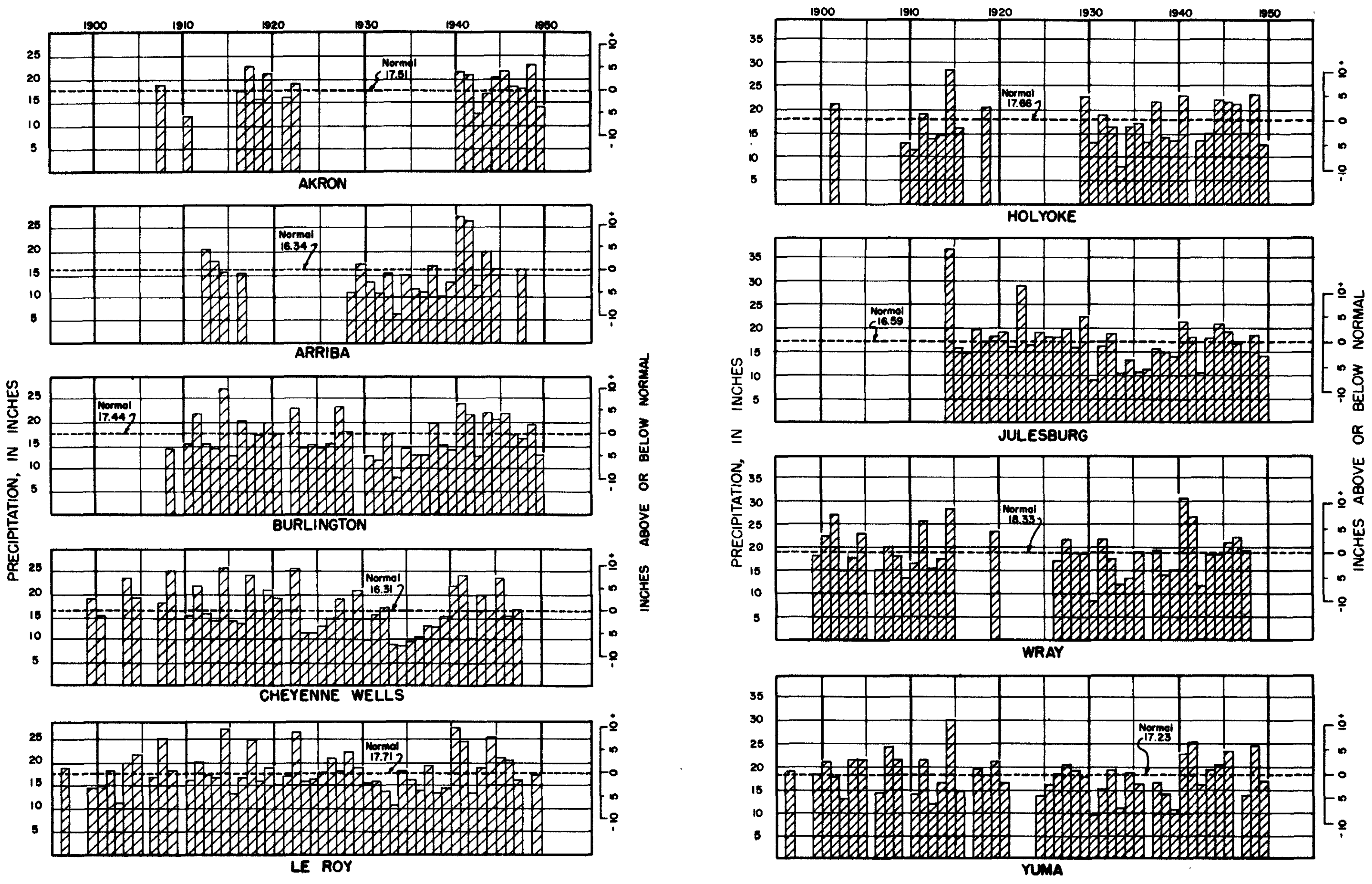


Figure 4.--Annual precipitation at Akron, Arriba, Burlington, Cheyenne Wells, LeRoy, Holyoke, Julesburg, Wray, and Yuma.

GEOLOGY

Stratigraphy

The exposed sedimentary rocks in the region range in age from Late Cretaceous to Recent. The oldest formation is the Pierre shale which underlies the entire region and which crops out in the deeper valleys.

Most of the area from Wray northward to the South Platte valley is shown on the State Geologic map to be underlain by the Arikaree sandstone of Tertiary (Miocene) age. Available data indicate, however, that very little of the area is underlain by the Arikaree. Detailed mapping in the Wray area (Hill and Tompkin, 1953) has shown that the rocks previously mapped as Arikaree in that area are in large part the Ogallala formation. Hydrologic data obtained as a part of this investigation indicate that the Ogallala formation underlies most of the area previously mapped as the Arikaree sandstone. Wells throughout the area have specific capacities much greater than those of wells commonly found in areas underlain by the Arikaree. If the Arikaree underlies any of the Kansas River basin in Colorado, it is considered a part of the Ogallala formation for the purpose of this report.

The Ogallala formation crops out in many places in the area and ranges in thickness from a featheredge to several hundred feet. It is reported by Hill and Tompkin (1953) to be overlain locally by the Grand Island formation of Pleistocene age (here considered a part of the Ogallala), and in the eastern and southern parts of the area it is overlain by the Sanborn formation of Pleistocene and Recent(?) age. Dune sand, which mantles large areas in the northern part of the region, probably is of Pleistocene to Recent age. Alluvium of Recent age underlies the channels and flood plains of some of the streams.

The geology of the region was not mapped during the investigation. Surficial materials are not identified by stratigraphic terms in the logs (table 2) except where the drillers' logs indicate accurate lithologic subdivisions.

Geologic formations and their water-bearing properties

Cretaceous system

Pierre shale (Upper Cretaceous).--The Pierre shale underlies the entire region and crops out in the eastern lower reaches of the valleys of the Arikaree and North Fork of the Republican River, in bluffs at Flagler and Genoa, and at a few other places where the streams have cut through the mantle of younger materials.

Weathered outcrops of the Pierre shale are light to dark gray and fresh exposures are generally dark gray, blue, or black. The Pierre contains numerous concretions of limonite and calcium carbonate. The shale is overlain in many areas by a dense yellow clay (sometimes called soapstone by drillers and local residents) ranging in thickness from a featheredge to several feet. This clay probably was formed by weathering of the Pierre shale in early Tertiary time.

The Pierre shale is relatively impermeable and yields water only sparingly to wells from fractured zones, openings along bedding planes, or thin beds of sand within the formation. The water generally is of poor quality and is not available in quantities sufficient for irrigation.

The Pierre shale ranges in thickness from about 600 feet in Wallace County, Kans., to about 1,400 feet in northwestern Cheyenne County, Kans., and thickens westward to about 1,490 feet in T. 2 S., R. 43 W., Yuma County, Colo., and to about 2,560 feet in T. 1 S., R. 49 W., Washington County, Colo.

Regionally, the eroded surface of the Pierre shale appears to be relatively smooth (see pl. 2); locally, however, the Tertiary streams probably eroded channels into the Pierre shale. A map showing the configuration of the erosion surface on the Pierre shale in parts of Cheyenne, Kit Carson, and Lincoln Counties (pl. 2) was prepared from logs of seismograph shot holes. The over-all erosion surface is smooth except where the Ogallala cover has been removed, as in the valley of Big Sandy Creek. Its smoothness is further illustrated by the diagrammatic cross section (pl. 3) which indicates that the erosion surface of the Pierre shale slopes north-northeastward at a rate of approximately 33 feet per mile.

Tertiary system

Ogallala formation (Pliocene).--The Ogallala formation is composed of silt, sand, gravel, caliche, and clay which appear, on cursory examination, to occur in lenses that interfinger in short vertical and horizontal distances. The sorting and continuity of the beds actually are better developed than they appear surficially to be (Fenneman, 1931, p. 13). In general, gravel and sand are concentrated in winding narrow bands extending in an easterly direction. The presence of these bands at any depth in the formation suggests that they represent former channels of the shifting streams that deposited the Ogallala formation. Silt, however, is the predominant material throughout the formation. The local concentration of sand and gravel was probably caused by more active stream erosion, which resulted in the washing away of the finer constituents and in leaving of the sand and gravel as residual material (Fenneman, 1931, p. 13).

The sand and gravel of the Ogallala formation is cemented in places by calcium carbonate and forms a fairly well indurated rock; in other places, it is well cemented into hard, resistant ledge-forming beds (the so-called mortar beds). Stringers of clay and caliche are present almost throughout the formation. Bentonitic clay, which occurs in the lower half of the Ogallala formation in some areas and which was described by Elias (1931, p. 153-158), is possibly present in eastern Colorado. A hard, opalescent, porous rock containing grains of sand crops out in the area south of the Arikaree River. I have found in eastern Colorado no outcrops of indurated volcanic ash similar to those described by Elias (1931, p. 211).

One of the most widespread horizons is the capping "algal limestone," a reddish-brown, concentrically banded limestone that weathers to a miniature badlands surface. Elias (1931, p. 136-141) believes that this limestone was precipitated in part by the alga Chlorellopsis. The thickness of the bed is remarkably uniform in all studied exposures; it ranges from 2 to $3\frac{1}{2}$ feet.

The Ogallala formation yields water to wells throughout the region except where it thins to a featheredge. The water generally is of good quality and is suitable for stock, irrigation, domestic, and public supply. All towns in the region except Wray utilize water from the Ogallala formation for public water supply. The formation yields water to wells in sufficient quantity for irrigation in many areas, especially where wells tap saturated sand and gravel filling the channels of old Tertiary streams. Extensive test drilling to locate a possible buried channel is recommended before a well site is chosen. Calcium carbonate cement or clay, silt, and fine sand may reduce the permeability of the Ogallala in some areas to the extent that water in sufficient quantities for irrigation cannot be obtained.

The lithology of the Ogallala formation is graphically shown in the diagrammatic cross section of part of Kit Carson County, Colo. (pl. 3), which was prepared from the drillers' logs of seismograph shot holes. The position of the water table in the diagram is based on measured water levels and on water levels reported by residents in the area. The cross section shows that the depth to water, as well as the saturated thickness, determines the possible extent of irrigation-well development. Some of the southeastern part of the area shown in the diagrammatic cross section is underlain by the Sanborn formation, but the depth to the contact between the Sanborn and Ogallala formations could not be determined in the drillers' logs.

Quaternary system

Sanborn formation (Pleistocene).--The Sanborn formation of Pleistocene and Recent(?) age consists mainly of yellow-buff porous unstratified and unconsolidated loess. The

Ogallala is overlain locally by this formation. Farther east, in Wallace, Sherman, and Cheyenne Counties, Kans., the formation is thicker and is much more widespread. The Sanborn formation lies above the water table in this region and, hence, does not yield water to wells.

Dune sand (Pleistocene to Recent).--The dune sand of Pleistocene to Recent age in the northern part of the region consists largely of reworked material derived from the Ogallala formation. The dune sand yields water to stock wells where the water table is close to the surface. The hydrologic importance of the dune-sand area, however, is due to its ability to absorb water rapidly. Because of the high porosity and permeability of the dune sand and because of the poorly developed surface drainage, much of the water from precipitation percolates downward to the zone of saturation and little water is lost by runoff, evaporation, or transpiration.

Alluvium (Recent).--Alluvium of Recent age, consisting of gravel, sand, silt, and clay, underlies the flood plains of the major streams. The alluvium yields moderate amounts of water to stock and domestic wells and supplies irrigation wells in the Arikaree Valley near Cope. Alluvium of the North Fork of the Republican River yields water to domestic and stock wells and to the municipal wells at Wray.

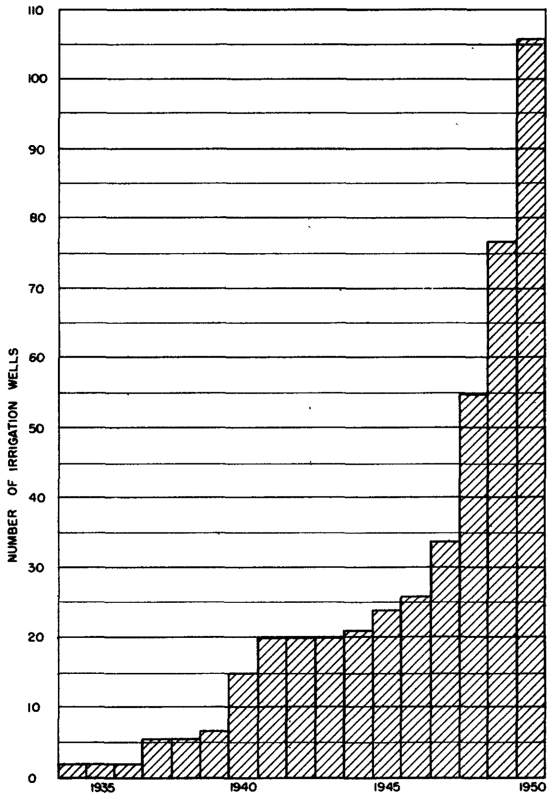


Figure 5.--Cumulative number of irrigation wells. Wells constructed before 1934 and now used for irrigation are not included because they were intended originally to be used for other purposes. Wells for which the year of construction could not be determined also are not included.

USE OF GROUND WATER

Development of irrigation

Irrigation is a comparatively new undertaking for most of the ranchers and farmers in eastern Colorado. Since 1947 the number of irrigation wells in the region has more than trebled, and the number of newly constructed irrigation wells is increasing markedly each year (see fig. 5). The drillers of the region are busy with additional installations at the present time (April 1951). Although mistakes have been made, well owners are rapidly improving their irrigation methods and more efficient pumping plants are being installed. Crops that can be irrigated most profitably are receiving more attention, and many owners keep careful records of the cost of fuel for pumping, the fuel consumption, and the production increase. Alfalfa is probably the principal irrigated crop and various row crops are next in importance. Pasture and wheat also are irrigated in some places.

Summary of well data

Data compiled for wells in the region (see table 1) are summarized on the following page.

Use of water from inventoried wells

County	Number of wells for indicated use					
	Irrigation		Public supply	Water-level observation	Stock	Cemetery
	Now in use	Additional to be used				
Cheyenne............	2	2	3	1	0	0
Kit Carson..........	16	12	15	3	1	1
Lincoln.............	5	0	2	0	0	0
Logan...............	1	0	3	2	0	0
Phillips............	7	1	4	2	1	0
Sedgwick............	1	0	0	0	0	0
Washington..........	36	14	6	4	0	0
Yuma................	22	2	8	0	1	0
	90	31	41	12	3	1

Yield and specific capacity of irrigation wells

[E, estimated or reported; M, measured]

County	Yield			Specific capacity		
	Number of wells	Range (gpm)	Average (gpm)	Number of wells	Range (gpm/ft)	Average (gpm/ft)
Cheyenne.............	4	100E - 400E	175	1	20	20
Kit Carson...........	22	125E - 1,600E	700	10	20 - 125	41
Lincoln..............	5	241M - 1,000E	468	0	....	...
Logan................	1	600E	600	1	100	100
Phillips.............	7	485M - 1,500E	1,114	7	9 - 123	85
Sedgwick.............	1	660E	660	1	26	26
Washington...........	40	100E - 1,213M	630	9	32 - 243	79
Yuma.................	22	110E - 1,650E	823	20	10 - 116	44
	102	100E - 1,650E	697	49	10 - 243	56

Depth of irrigation wells

[R, reported; M, measured]

County	Number of wells	Range (feet)	Average (feet)
Cheyenne..................................	4	13.6M - 72.3M	45
Kit Carson................................	24	17.5M - 308R	111
Lincoln...................................	5	110R - 260R	148
Logan.....................................	1	78R	78
Phillips..................................	7	198R - 272R	225
Sedgwick..................................	1	320R	320
Washington................................	45	13.5M - 76.8M	47
Yuma......................................	23	28.0M - 326R	154
	110	13.5M - 326R	101

Area irrigated in 1950 and prospective irrigated area

County	1950				Prospective			
	Number of wells for which information was obtained	Area irrigated (acres)	Total number of wells in use	Estimated area irrigated (acres)	Number of wells for which information was obtained	Area to be irrigated (acres)	Total number of wells to be used	Estimated area to be irrigated (acres)
Cheyenne..................	2	50	2	50	3	150	4	200
Kit Carson................	10	990	16	1,600	19	1,840	28	2,700
Lincoln...................	5	740	5	740	5	740	5	740
Logan.....................	1	15	1	15	1	15	1	15
Phillips..................	7	875	7	875	7	875	8	1,000
Sedgwick..................	1	160	1	160	1	160	1	160
Washington................	25	1,221	36	1,800	31	1,601	50	2,100
Yuma......................	15	1,709	22	2,500	19	2,309	24	3,400
	66	5,760	90	7,700	86	7,690	121	10,300

Depth to water below land surface, drawdown, and pumping lift of irrigation wells

[R, reported; M, measured]

County	Depth to water below land surface			Drawdown			Pumping lift		
	Number of wells	Range (feet)	Average (feet)	Number of wells	Range (feet)	Average (feet)	Number of wells	Range (feet)	Average (feet)
Cheyenne....	4	8.3M - 29R	20	1	5	5	1	13	13
Kit Carson..	26	5.0M - 191.8M	58	10	5 - 58	28	10	16 - 206	83
Lincoln.....	5	60R - 200R	94	0	....	..	0	....	...
Logan.......	1	52.6M	52.6	1	6	6	1	59	59
Phillips....	7	39.9M - 148.2M	76	7	10 - 53	18	7	53 - 201	94
Sedgwick....	1	202.5M	202.5	1	25	25	1	227	227
Washington..	46	9.8M - 47.9M	27	9	5 - 28	16	9	28 - 61	41
Yuma........	24	6.6M - 230.2M	73	20	7.5 - 60	27	20	19 - 251	102
	114	5.0M - 230.2M	51	49	5 - 60	23	49	13 - 251	86

Possibilities for development of irrigation from wells

Wells of large yield situated between areas where irrigation wells locally are numerous indicate that irrigation from wells probably could be developed throughout broad areas at the present time. Irrigation from wells also may be feasible in the future in other areas where the total lift now is too great for economical development of the ground-water resources. These marginal areas, however, might reasonably be opened to extensive pump irrigation at an earlier date if a cheap fuel, such as natural gas, became available. Of interest in this regard is the recent leasing by oil producers of large areas in northeastern Colorado.

Irrigation development in large areas in the region cannot be condemned or endorsed categorically without detailed ground-water studies. The lenticular character and the wide range in the permeability of the water-bearing beds in the Ogallala formation and the narrowness of the underlying Tertiary stream channels make it possible to obtain wells of high yields close to those of much lower yields. For these reasons, local lines of test holes should be drilled before the site of an irrigation well is selected. Inasmuch as the braided Tertiary streams that laid down the sand and gravel of the Ogallala formation generally flowed from the Rocky Mountains in the same direction as the present-day streams, it seems advisable to test drill as nearly as possible at right angles to their courses--that is, in north-south or northeast-southwest lines--in order to locate the more permeable water-bearing materials.

Additional irrigation wells almost certainly will be drilled southeast of Holyoke in the Frenchman Creek basin. (See pl. 1.) The water table is comparatively shallow and the average yield of all the pumped wells is more than 1,000 gpm. The depth to the water table gradually increases from approximately 50 feet in the Frenchman Creek valley to more than 200 feet in southern Sedgwick County; therefore, the water table in the area south of Amherst probably is about 125 feet below the surface. The high average specific capacity of wells in Phillips County indicates that pumping water for irrigation probably would be profitable in that area. (See table 1.) Irrigation by flooding methods is feasible in this area as the land is relatively level and the soil is less sandy than elsewhere in the region.

The yield of well B6-50-14da in Logan County is reported to be 600 gpm and the drawdown is reported to be 6 feet; if these figures are correct, then the specific capacity of this well is 100 gpm per foot of drawdown. The static water level in this well is about 53 feet below the land surface. Little information has been obtained for the area between this well and those southeast of Holyoke, but conditions for using water from wells for irrigation can be assumed to be reasonably favorable in parts of this area.

Irrigation by sprinkling probably will increase slowly in the area of dune sand south of Holyoke and north of Wray, particularly in areas of mature dunes where soils are more completely developed. The water table is shallow and the aquifer is moderately permeable, as indicated by data for well B5-43-24ab, which reportedly yields 1,650 gpm with a drawdown of 19 feet.

From the dune-sand area westward to the limits of the Kansas River basin, the increase of irrigation probably will be slow. Much of the area is sandy and irrigation by sprinkler systems generally would be required. The water table in this area is reported to be deep.

More irrigation may be done in the valley of the North Fork of the Republican River both east and west of Wray if both surface water from the river and ground water from the alluvium and from the Ogallala formation are utilized. Well B2-42-2cc east of Wray yields 750 gpm with a drawdown of 18 feet; there, however, the Pierre shale lies at a depth of only 65 feet.

Very little irrigating has occurred in the large area that extends southward from U. S. Highway 34 to the Arikaree Valley. Inasmuch as the area is sandy, future development, if any, will be slow and of necessity mostly by sprinkler systems. There also the water table is reported to be generally deep.

The greatest use of wells for irrigation has been in the Arikaree valley in the vicinity of Cope. More wells utilizing ground water from both the alluvium of the Arikaree River and from the Ogallala formation could be developed there. In the western part of the Arikaree River basin north of Genoa, Bovina, and Arriba, irrigation by ground water from the alluvium may be developed. Although the water is considered hard by the local residents, it probably is suitable for irrigation. The water table on the tributary divides, however, is deep, and it is doubtful whether water from the Ogallala formation will be used for irrigation in that area.

From Cope northwestward to Anton, farmers have difficulty in obtaining sufficient water for stock wells. The top of the Pierre shale is reported to be near the surface and the zone of saturation above it, where present, is very thin.

East of Cope, near Joes and Kirk, the water table is about 100 feet below the surface, and the yield from wells in the area ranges from 344 gpm to 1,350 gpm. The average yield is 726 gpm, and the average drawdown is 24 feet. Many irrigation wells probably will be developed in this area. Farther east, north of Idalia, the water table is more than 200 feet below the land surface; however, the large yield of the wells and the good soil have encouraged the construction of a few irrigation wells.

Northeast of Cope along the Arikaree valley to the Kansas State line, irrigation from wells possibly could be increased extensively. The Ogallala formation yields water to wells at shallow depths in this area, and, where the Ogallala is thin, water for irrigation probably could be obtained from wells in the alluvium.

Irrigation wells are now widely scattered along the South Fork of the Republican River. More wells probably could be drilled between the existing ones and could be pumped without excessive lowering of water levels.

The conditions for development of irrigation from wells in the Landsman Creek valley are similar to those in the Arikaree valley northeast of Cope.

More irrigation wells could be installed in the area of the North Fork of the Smoky Hill River southeast of Burlington, as well as in the area south of Burlington in the basins of Sand and Beaver Creeks. The depth to water in an observation well 0.5 mile west of Burlington is 170 feet; it is about 120 feet in the valley of Beaver Creek and about 90 feet in the valley of Sand Creek. (See pl. 3.) The water table is shallow in T. 10 S., Rs. 42 and 43 W., and in the southern part of R. 44 W., and for this reason development of ground water for irrigation in these areas is very likely. Likewise, T. 9 S., R. 42 W. appears to be a favorable area for development of irrigation. The depth to the water table is progressively greater from R. 44 W. to R. 47 W. About the only other area where the water table is shallow is in the valley of Spring Creek near Vona.

Farther south from Burlington, the development of irrigation probably will be slow and will be restricted mainly to irrigation from wells in the alluvium of the South Fork of the Smoky Hill River and its tributaries. The depth to water below the topographic divides in this area appears to be too great for the economical development of the ground water for irrigation at the present time. Little information about ground water was obtained in large areas in the region because field data were collected only in those areas where some irrigation by pumping has already begun. Possibly some of these relatively unexplored areas may ultimately be developed.

Widespread irrigation is unlikely in the extensive areas of dune sand because the soil is poorly developed and the slopes are steep. Irrigation is unlikely also near the periphery of the outcrop of the Ogallala formation because the zone of saturation in the formation is too thin.

Municipal water supplies

Sixteen municipalities in the region obtain their public water supplies from wells. All except Wray, which obtains water from the alluvium or terrace deposits (or both) of the

North Fork of the Republican River, obtain water from the Ogallala formation.

Akron

Akron is supplied by 5 wells (B2-52-17cb, -17cc, 3-52-8aa, -8bd, and -17da) that range in depth from 41.5 to 170 feet; the static water level in these wells ranges in depth from 13.6 to 110 feet, and the yields range from 35 to 1,000 gpm. All the wells are equipped with electrically driven turbine pumps. A ground-level reservoir at the northwest edge of town has a capacity of 1,000,000 gallons, and an elevated tank on the highway 1 block east of Main Street has a capacity of 100,000 gallons. Water is pumped to the reservoirs and mains by the well pumps. The water is chlorinated and an estimated 260,000 gallons is consumed daily.

Arriba

Arriba is supplied from 2 wells, C9-53-12aa1 and -12aa2, which are equipped with electrically driven turbine pumps. The wells are about 85 feet deep and the depth to water is about 70 feet. Well C9-53-12aa1 pumps about 39 gpm and well C9-53-12aa2 pumps about 49 gpm. The pneumatic reservoir has a capacity of 18,000 gallons. An estimated 23,600 gallons of water is consumed daily.

Bethune

Bethune is supplied from 1 well, C8-45-34cc, which is equipped with an electrically driven turbine pump. The well is 230 feet deep, the depth to water is 162 feet, and the yield is reported to be 125 gpm. Storage is provided by an 11,500-gallon elevated tank. The water is pumped directly into the mains. The average daily consumption is reported to be 3,300 gallons.

Burlington

Burlington is supplied from 3 wells: C8-44-36cd at the corner of 15th Street and U. S. Highway 24, C8-44-36db at the corner of 14th and Railroad Streets, and C8-44-36dd at the corner of 10th Street and Lowell Avenue. All wells are equipped with electrically driven turbine pumps. The wells range in depth from 230 to 350 feet and the depth to water in all wells is reported to be 150 feet. The yield of the wells ranges from 300 to 500 gpm. Storage is provided by a 50,000-gallon elevated tank on the north side of town. All wells pump directly into the mains. The average daily consumption is reported to be 300,000 gallons.

Cheyenne Wells

Cheyenne Wells is supplied from 3 wells (C14-44-20dc1, -20dc2, and -20dc3) in the southern part of town. Each well is equipped with an electrically driven turbine pump. The wells range in depth from 265 to 365 feet and the static water level is about 250 feet below land surface. The yield of well C14-44-20dc1 is not known; the yield of wells C14-44-20dc2 and -20dc3 are reported to be 300 gpm and 200 gpm, respectively. An elevated tank northwest of town provides storage for 85,000 gallons. Although the water apparently is of good quality, chlorine is used for precautionary sanitation. Sand, which sometimes is pumped with the water, damages the water meters. The average daily water consumption is reported to be 264,000 gallons.

Eckley

Eckley is supplied from 1 well (B2-46-26bc) which is 317 feet deep, in which the static water level is 45 feet below the land surface and the yield is 200 gpm. The well is equipped with an electrically driven turbine pump. Storage is provided by an elevated tank that has a capacity of 50,000 gallons. Water is pumped directly into the mains. The average daily consumption is 20,000 gallons.

Flagler

Flagler is supplied from 2 wells (C9-51-2ac and -2bd) that are equipped with electrically driven turbine pumps. The depth of the wells is about 100 feet. The water level in well C9-51-2ac is about 92 feet and the water level in the other well is about 63 feet below the land surface. Well C9-51-2ac is reported to yield about 100 gpm and well C9-51-2bd about 220 gpm. A 100,000-gallon elevated tank near the high school is used for storage. The water is pumped directly into the mains. The average daily consumption is estimated to be 83,000 gallons.

Fleming

Fleming is supplied by 3 wells. Well B8-49-9ad1 at the elevated storage tank is 165 feet deep, is equipped with an electrically powered cylinder pump, and yields approximately 12 gpm. It is used only in the summer during periods of water shortage. Well B8-49-9ad2 is 200 feet deep and the static water level is about 125 feet below land surface. This well is equipped with an electrically driven turbine pump and yields 22 gpm. Well B8-49-10bb is also 200 feet deep, has an electrically driven turbine pump, and yields 50 gpm. Storage is provided by a 50,000-gallon elevated tank west of town. The water is pumped directly into the mains. A reported 33,000 gallons is consumed daily.

Genoa

Genoa is supplied by springs that issue at the contact of the Ogallala formation with the underlying Pierre shale southeast of town. The yield of approximately 10 gpm is collected in a concrete reservoir and thence is pumped to the town.

Haxtun

Haxtun is supplied from 2 wells. Well B8-47-21cc, at the power plant, is 233 feet deep. The static water level in this well is 150 feet below the land surface and the yield of the well is 565 gpm. Well B8-47-29aa is near the railroad and is 225 feet deep. The static water level is 142 feet below the land surface and the well yields 500 gpm. Both wells are equipped with electrically driven turbine pumps. Storage is provided at the power plant by an elevated tank. The water is pumped both directly into the mains and into the storage tank. No data on the consumption were obtainable.

Holyoke

Holyoke is supplied from 2 wells, well B7-43-17bc at the city park and well B7-44-7dd at the power plant. The depth of well B7-43-17bc is 265 feet, the static water level is 139 feet below land surface, and the yield is 625 gpm. Well B7-44-7dd is 223 feet deep, the static water level is 129 feet below the land surface, and the yield is 500 gpm. Both wells are equipped with electrically driven turbine pumps. Storage is provided by an 85,000-gallon standpipe in the city park. The water is pumped directly into the mains.

Otis

Otis is supplied from 1 well (B2-50-9dd), which is 233 feet deep and at the west end of town. The static water level in the well is 220 feet below the land surface and the yield is 300 gpm. The well is equipped with an electrically driven turbine pump. Storage is provided by a surface reservoir at the water works and an elevated tank at the city hall; the combined storage capacity is 105,000 gallons. The water is pumped directly into the mains and into the surface reservoir. The average daily consumption is 70,000 gallons.

Seibert

Seibert is supplied from 3 wells. Wells C9-49-3bc1 and -3bd are equipped with electrically driven cylinder pumps and well C9-49-3bc2 is equipped with an electrically driven turbine pump. The depth of the wells is about 150 feet, and the water level in the wells is about 140 feet below the land surface. Wells C9-49-3bc1, -3bc2, and -3bd are reported to yield about 300 gpm, 600 gpm, and 125 gpm, respectively. Storage is provided by a 50,000-gallon standpipe northeast of town. The water is pumped directly into the mains and chlorine is used as a safeguard. The average daily consumption is about 30,000 gallons.

Stratton

Stratton is supplied from 3 wells. Wells C8-47-36ca1 and -36ca2 were drilled in 1922 and are 30 feet apart; well C9-49-1ba was drilled in 1949. All are equipped with electrically driven turbine pumps. The depth of well C9-47-1ba was reported to be about 230 feet, the water level slightly more than 150 feet, and the yield about 500 gpm. Comparative data for the other wells were unobtainable. The water is stored in a 50,000-gallon elevated tank. The older wells pump into the tank, and the newer well pumps directly into the mains. The average daily consumption is reported to be 26,000 gallons.

Vona

Vona is supplied from 2 wells (C9-49-2bb1 and -2bb2) that are equipped with wind-operated cylinder pumps, and from 1 well (C9-48-2bb3) that is equipped with an electrically driven turbine pump, which is used when the wind is not blowing sufficiently for the pumps on the other wells to operate. Well C9-48-2bb3 is 80 feet deep, and the static water level in the well is 60 feet below the land surface. The yield is reported to be 300 gpm. Generally, the water is pumped directly into the mains; however, a tank is used for storage. The average daily consumption is reported to be 10,800 gallons.

Wray

Wray is supplied by 5 wells (B1-43-6bc, -6bd1, -6bd2, -6bd3, and -6bd4). The wells are about 75 feet deep, the static water level in the wells is about 60 feet below the land surface, and the yields range from 97 to 250 gpm. The wells are equipped with electrically driven turbine pumps. Storage is provided by a cemented dug pit south of town, which has a capacity of 300,000 gallons.

Yuma

Yuma is supplied from 2 wells in the northwestern part of town. Both wells are about 315 feet deep, and the static water level in the wells is about 180 feet below land surface. Well B2-48-22ac1 yields 300 gpm, and well B2-48-22ac2 yields 500 gpm. Both are equipped with electrically driven turbine pumps. Storage is provided by a surface reservoir northwest of town and a tank south of town; the combined storage capacity is 200,000 gallons. An average of 400,000 gallons of water is used daily.

OBSERVATION WELLS

Fluctuations of the water level in wells reflect the changes of the amount of ground water in storage. The principal sources of recharge to the ground-water reservoirs in this region are precipitation that reaches the water table by downward percolation and influent seepage from streams, especially in times of flood. Ground water is discharged from storage by effluent seepage into streams; by evaporation and transpiration, particularly where the water table is near the surface; by the flow of water from springs; by pumping from wells; and by subsurface flow out of the region.

Twenty-two wells in the region were selected for use in water-level observations. Most of these wells are in the areas of the greatest concentration of irrigation wells. Ten of the observation wells are abandoned stock or domestic wells, one is a stock well, and the remainder are irrigation wells. Monthly measurements of the water level have been made, but the measurements to date (1951) indicate no significant trend on a regional scale. Pertinent data for all observation wells are listed in table 2. The location of the wells is shown on plate 1.

CONCLUSIONS

The ground-water resources have not been fully developed in any part of the Kansas River basin in Colorado. Little intensive irrigation is practiced in the region; most irrigation water is used to supplement rainfall, and it is used only at a few critical times during the growing season. More pumping plants could be installed and operated in the present areas of irrigation concentration without excessive lowering of ground-water levels. However, as much information as possible on ground-water conditions should be collected while irrigation in the region is being developed, so as to provide a basis for orderly development.

In order to determine the perennial yield of ground water in the region, a detailed ground-water investigation would be needed. A water-table contour map should be prepared for at least the major stream valleys; water-level measurements should be continued indefinitely; the geology should be mapped; maps showing the depth to water and the saturated thickness should be prepared; pumping tests should be made in order to determine the transmissibility and storage coefficients of the aquifers; and the effect of pumping on stream flow should be determined. A program of test drilling would be necessary in those areas where little or no information on subsurface conditions is available. A detailed appraisal of ground-water conditions in the relatively unproved areas would be particularly essential. For example, in many places in the area of dune sand north of Wray the soil is maturely developed, but the depth to water and the thickness of water-bearing materials are unknown.

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RECORDS OF WELLS

Data recorded at the time the wells were visited are tabulated in the following table.

Table 1.--Records of wells in the Kansas River basin in eastern Colorado

Well number: See text for description of well numbering system.
Type of well: DD, drilled and dug; Dr, drilled; Du, Dug.
Depth of well: Reported depths are given in feet below land surface; measured depths are given in feet and tenths of feet below measuring point.
Type of casing: C, concrete (brick, tile, or pipe); G, galvanized iron; I, iron; N, none; S, steel; W, wood.
Character of material: G, gravel; S, sand.
Geologic source: A, alluvium; D, dune sand; O, Ogallala formation.
Method of lift (first letter): C, centrifugal; Cy, cylinder; J, jet; N, none; T, turbine.
Type of power (second letter): B, butane engine; D, diesel engine; E, electric motor; G, gasoline engine; H, hand operated; N, none; T, tractor; W, windmill.
Use of well: C, cemetery; I, irrigation; NI, new irrigation well (not yet used); O, observation; P, public supply; S, stock.
Measuring point: Bcop, bottom of cutout in pump; Bhc, bottom of hole in casing; Bpb, bottom of pump base; Ls, land surface; Stp, center line of priming pipe; Tah, top of air hole; Tc, top of casing; Tpb, top of pump base; Tpj, top of pump jack; Twc, top of well curb.
Depth to water: Measured depths to water level are given in feet, tenths, and hundredths; reported depths to water level are given in feet.
Remarks: A, present irrigated acreage; B, member of battery of wells; D, drawdown in feet; L, log of well included in log tables; P, immediately prospective irrigated acreage; S, sprinkler system; X, reported depth to Pierre shale; Y, estimated yield in gallons a minute; Y and M, measured yield in gallons a minute.

Well no.	Owner	Year drilled, 19--	Type of well	Depth of well (feet)	Diameter of well (inches)	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift and type of power	Use of well	Measuring point: Description	Measuring point: Distance above or below (-) land surface (feet)	Depth to water level below measuring point (feet)	Date of record	Remarks
Cheyenne County															
C12-44-24aa	....	..	Dr	160	5	G	...	O	N	O	Tc	0.4	153.10	9- 7-50	
C13-42- 6bc	W. G. Kuttler.......	49	Dr	73.8	12	G	S,G	O	T,T	NI	Tc	1.5	16.09	9- 6-50	Y400, P100, L, S.
44-22cd	Elmer Sharp.........	16	Du	15.6	14-18	G	S,G	A	N	NI	Tc	2.0	10.31	9- 6-50	Y100, D5.
45-17dd1	Vern Haney..........	50	Dr	49	16	G	G	O	T,G	I	Ls	....	29	9- 6-50	Y100, A25, B, S.
17dd2	.....do.............	50	Dr	46	20	G	G	O	T,G	I	Ls	....	29	9- 6-50	Y100, A25, B, S.

C14-44-20dc1	Town of Cheyenne Wells.	31	Dr	265	.....	...	S	O	T,E	P	Ls	....	245	9- 5-50	Y135.
20dc2	.....do............	49	Dr	365	8	S	S,G	O	T,E	P	Ls	....	255	9- 5-50	Y300, L.
20dc3	.....do............	46	Dr	355	8	S	S	O	T,E	P	Ls	....	245	9- 5-50	Y200, L.
	Kit Carson County														
C 6-45- 3ab	Frank McDonald......	48	Dr	101	18	G	G	A,O	T,T	I	Ls	....	13	8-30-50	Y1,000, P110, L, S.
46- 8db	Edwin Street........	49	Dr	207	16	G	S,G	O	T,D	I	Ls	....	110	7-20-50	Y824M, A100, S.
27da	Lloyd Pugh..........	50	Dr	96	18	G	S,G	A,O	N	NI	Tc	1.0	13.03	10-12-50	Y1,500, D12, L.
50-29cc	Homer Huntzinger....	48	Dr	167	.....	...	S,G	O	T	I	....	....	......	8-11-50	A160, L, S.
30bd	.....do............	48	Dr	206	.....	...	S	O	T,D	I	....	....	......	8-11-50	A80, L.
31ba	Henry Witte.........	48	Dr	201	30	S	G	O	N	NI	Tc	.2	158.48	8-11-50	Y900, X201.
C 7-45-29ac	John Schritter......	50	Dr	308	18	G	G	O	T,D	I	Bpd	2.0	184.70	8-28-50	Y1,050, D23, P200.
50-31cc	John Williams.......	50	Du	18.3	20	C,S	S	A	N	NI	Tc	.0	4.98	8-25-50	Y400, D12, P120.
C 8-44-36cd	Town of Burlington..	50	Dr	350	18	G	S,G	O	T,E	P	....	....	......	7-24-50	Y500, L.
36db	.....do............	28	Du	230	18-48	C	S,G	O	T,E	P	Ls	....	180	7-24-50	Y300, D15, L, X341.
36dd	.....do............	46	Dr	245	18	G	S,G	O	T,E	P	....	....	......	7-24-50	Y500.
C 8-45-34cc	Town of Bethune.....	48	Dr	230	8	S	S,G	O	T,E	P	Ls	....	162	8-12-50	Y125, X228.
46-31dc	Town of Stratton....	..	Dr	205.5	5	G	S,G	O	T,E	C	Ls	2.5	178.98	10-12-50	
47-36ca1	.....do............	22	Dr	.....	.....	...	S,G	O	T,E	P	....	....	......	8-12-50	
36ca2	.....do............	22	Dr	.....	.....	...	S,G	O	T,E	P	....	....	......	8-12-50	
C 8-49-15bb	Ernest Acres........	41	Du	23	42-24	S	G	A	N	NI	Tc	2.0	7.99	8- 4-50	Y650, D13, P60, S, X21.
16aa1	Harley Greenlee.....	50	Du	24	10	G	S,G	A	C,G	I	Ls	....	9	8- 4-50	Y150, A30, B, S.
16aa2	.....do............	50	Du	15.1	24	G	S,G	A	C,G	I	Tc	-4.6	1.62	8- 4-50	Y200, A30, B, S.
17cc	.....do............	50	Dr	19.0	18	S	S,G	A	N	NI,O	Tc	1.5	10.98	8- 4-50	Y125, P50.
18dd1	Earl Bigelow........	50	Du	18	32	G	G	A	N	NI	Ls	....	12	8- 4-50	Y150.
18dd2	.....do............	50	Du	18	24	G	G	A	N	NI	Ls	....	12	8- 4-50	Y150.
18dd3	.....do............	50	Du	22	8	G	G	A	C,G	I	Ls	....	11	8- 4-50	Y150, D5, A20, S.
21cd	Virgil Fuller.......	48	Dr	30	18	G	S,G	A	N	NI	Ls	....	15	8-16-50	Y500, D12, P60, S, X30.
C 8-51- 1cd1	Kenneth Mort........	50	Dr	26.6	18	G	G	A	N	NI	Tc	1.6	12.43	8-16-50	Y140, P25, B, S, X70.
1cd2	.....do............	50	Dr	26.9	18	G	G	A	N	NI	Tc	1.6	12.47	8-16-50	Y200, P25, B, S, X70.
10ab	George Hubbard......	49	Dr	74	18	G	S,G	O	T,P	I,O	Tpb	.8	31.61	11- 1-50	Y645M, D30, A60, X112.
33cc	....	..	..	.....	24	C	...	......	N	O	Tc	.0	73.67	8- 2-50	
C 9-44- 2bb	....	..	Dr	187.1	5	G	...	......	N	O	Tc	.3	174.97	7-29-50	
46- 9bc	James Leffler.......	51	Dr	.....	18	G	...	O	N	NI	Tc	.9	192.74	4- 8-51	
47- 1ba	Town of Stratton....	49	Dr	245	.....	...	S,G	O	T,E	P	....	....	......	8-12-50	Y500, L.

Table 1.--Records of wells in the Kansas River basin in eastern Colorado--Continued

Well no.	Owner	Year drilled, 19--	Type of well	Depth of well (feet)	Diameter of well (inches)	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift and type of power	Use of well	Measuring point: Description	Measuring point: Distance above or below (-) land surface (feet)	Depth to water level below measuring point (feet)	Date of record	Remarks
	Kit Carson County--Continued														
C 9-48- 2bb1	Town of Vona........	18	Du	.....	.....	...	S,G	O	Cy,W	P	....	....	......	8-16-50	
2bb2	.....do.............	18	Du	.....	.....	...	S,G	O	Cy,W	P	....	....	......	8-16-50	
2bb3	.....do.............	..	DD	80	18	G	S,G	O	T,E	P	Ls	....	60	8-16-50	Y300.
49- 3bc1	Town of Seibert.....	23	Dr	150	7	S	S,G	O	Cy,E	P	Ls	....	142	9- 1-50	Y300.
3bc2	.....do.............	23	Du	150	60	C	S,G	O	T,E	P	Ls	....	139	9- 1-50	Y650.
3bd	.....do.............	23	Du	150	36.5	C	S,G	O	Cy,E	P	Ls	....	142	9- 1-50	Y125.
50- 7bb	....	..	Dr	32.5	5	G	...	......	N	O	Tc	.6	27.05	8-11-50	
51- 2ac	Town of Flagler.....	35	Du	100	72-60	C,S	S,G	O	T,E	P	Ls	....	92	9- 1-50	Y100, D6.
2bb	Walter Hasz.........	48	Dr	112	18	S	G	O	T,P	I	Bpb	2.0	84.99	7-28-50	Y500, A70, L, X110.
2bd	Town of Flagler.....	47	Dr	100	12	G	S,G	O	T,E	P	Ls	....	63	9- 1-50	Y220.
C10-42-30cb	A. G. Kirschmer.....	48	Dr	.....	.....	...	S,G	O	T,B	I	Tah	.8	57.60	8-31-50	
43-11ba	J. V. Brown.........	51	Dr	.....	18	G	...	O	N	NI	Tc	.6	136.90	3-14-51	P200.
25bb	A. G. Kirschmer.....	48	Dr	200	18	G	G	O	T,B	I	Tc	.3	95.35	8-31-50	Y1,575, D58, L.
27cc	.....do.............	48	Dr	263	18	G	G	O	T,D	I	Tc	.5	115.46	8-31-50	Y1,600, D55, L, X261.
35bb	.....do.............	48	Dr	247	18	G	S,G	O	T,D	I,O	Tc	.4	90.34	7- 1-50	Y1,400, L, X246.
C11-43-11ca	Mrs. Maurice Zorn...	48	Dr	.....	18	G	S,G	O	T,G	I	Bpb	.4	55.51	8-30-50	A120, S.
12bb	....	..	Dr	.....	6	S	...	......	Cy,H	S	Tc	.5	52.06	7- 1-50	
12cc	Floyd Powell........	48	Dr	237	18	G	G	O	T,D	I	Bpb	.7	80.94	8-30-50	Y1,570M, D56, A320, L, S, X263

							Lincoln County								
C 7-52-27ba	Harold Means........	49	Dr	260	18	G	S,G	0	T,D	I	Ls	....	200	8- 2-50	Y1,000, A100, L, S.
C 8-52-14dc	O. B. Sampson.......	49	Dr	134	18	G	G	0	T,B	I	Ls	....	84	8- 2-50	Y241M, A160, S, X129.
24aa	William Coryell.....	48	Dr	127	18	S	G	0	T,B	I	Ls	....	65	8- 2-50	Y500, A160, L, X127.
24cb	.....do.............	48	Dr	110	18	S	S,G	0	T,B	I	Ls	....	60	8- 2-50	Y300, A160, L.
24cc	.....do.............	48	Dr	110	18	S	S,G	0	T,B	I	Ls	....	60	8- 2-50	Y300, A160, L.
C 9-53-12aa1	Town of Arriba......	46	Dr	84.6	14	I	S	0	T,E	P	Tpb	-6.1	68.90	3- 1-50	Y39M, L.
12aa2	.....do.............	39	Du	85	70	C	S	0	T,E	P	Tpb	-5.9	70.75	3- 1-50	Y49.2M.
							Logan County								
B 6-50-14da	Gustave Marks.......	34	Du	78	18	S	S,G	0	T,G	I	Tc	0.7	53.34	9-29-50	Y600, D6, A15.
B 8-48-13dd	....	..	Dr	189.6	5	G	...	......	N	O	Tc	.0	157.18	9-25-50	
49- 9ad1	Town of Fleming.....	20	Du	165	6	S	S,G	0	Cy,E	P	....	....	......	9-29-50	Y12.
9ad2	.....do.............	49	Dr	200	8	S	S,G	0	T,E	P	Ls	....	125	9-29-50	Y22.
9da	Clyde Saylor........	..	..	.....	.....	...	...	......	Cy,H	O	Bpb	.5	109.41	9-29-50	
10bb	Town of Fleming.....	20	Dr	200	6	I	S,G	0	T,E	P	....	....	......	9-29-50	Y50.
							Phillips County								
B 7-42-17dd	Barney Dutton.......	..	Dr	96.6	6	G	...	......	Cy,H	S	Tc	0.7	66.66	10- 5-50	
43- 9bc	....	..	..	102.6	5	G	...	0	N	O	Bhc	.0	95.09	10- 5-50	
18ab	Irvin Heerman.......	49	Dr	230	18	S	S,G	0	T,D	I	Bpb	.0	93.60	9-22-50	Y1, 230M, D10, A80, L.
27bb	Clarence Barth......	39	Dr	215	18	S	S,G	0	T,B	I	Tah	.4	61.07	10- 5-50	Y1,400, D15, A200.
33ac	Guy Poe.............	41	Dr	236	18	S	G	0	T,D	I	Tpb	.2	60.41	9-22-50	Y1,000, D10, A125, L.
35ab	Harold Gerhardt.....	40	Dr	200	18	S	S,G	0	T,G	I,O	Tpb	.7	40.62	9-28-50	Y780M, D13, A60.
35bc	Max Fulsher.........	37	Dr	198	18	S	G	0	T,E	I	Ls	....	45	6-30-50	Y1,400, D15, A170.
44- 7dd	Town of Holyoke.....	21	Du	223	18	C	G	0	T,E	P	Ls	....	129	10- 6-50	Y500, L.
17bc	.....do.............	49	Dr	265	24	C	G	0	T,E	P	Ls	....	139	10- 6-50	Y625, D5, L.
20cb	....	..	Dr	.....	4	G	...	......	N	O	Tc	1.2	123.20	10- 2-50	
B 8-42-20db	Fred Sleep..........	51	Dr	.....	.....	...	...	......	N	NI	....	....	......	4-19-51	
32bc	Ernest Cranwell.....	49	Dr	222	18	S	G	0	T,G	I	Ls	....	81	9-25-50	Y1,500, D13, A80.
47-19bb	Reece Gueck.........	50	Dr	272	18	S	S,G	0	T,B	I	Bpb	.2	148.38	9-25-50	Y485M, D53, A160, S.
21cc	Town of Haxtun......	21	Du	233	18	C	S,G	0	T,E	P	Ls	....	150	10- 4-50	Y565, D18, L.
29aa	.....do.............	47	Dr	225	18	S	S,G	0	T,E	P	Ls	....	142	10- 4-50	Y500, D16, L.
							Sedgwick County								
B10-44-35ca	Mervin Renquist.....	49	Dr	320	18	S	G	0	T,D	I	Tpb	0.2	202.47	9-26-50	Y660, D25, A160, L, S.

Table 1.--Records of wells in the Kansas River basin in eastern Colorado--Continued

Well no.	Owner	Year drilled, 19--	Type of well	Depth of well (feet)	Diameter of well (inches)	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift and type of power	Use of well	Measuring point: Description	Measuring point: Distance above or below (-) land surface (feet)	Depth to water level below measuring point (feet)	Date of record	Remarks
							Washington County								
B 2-50- 9dd	Town of Otis........	35	Du	233	8	S	S,G	O	T,E	P	Ls	....	220	9-11-50	Y300, D4.
52- 8aa	Town of Akron.......	..	Du	170	84	C,G	G	O	Cy,E	P	Ls	....	110	7- 5-50	Y70, D57, X170.
8bd	.....do.............	..	Du	146	60	C,G	G	O	Cy,E	P	Ls	....	110	7- 5-50	Y35, D24.
17cb	.....do.............	..	Du	50	288	C	G	A	T,E	P	....	....	......	7- 5-50	Y240, D30, X50.
17cc	.....do.............	50	Dr	41.5	.....	...	G	A	Cy,E	P	Tpb	1.0	13.64	7- 5-50	Y1,000.
17da	.....do.............	..	Du	70	72-40	C,G	S,G	A	T,E	P	Ls	....	30	7- 5-50	Y70, D28, X70.
C 4-49-11db1	Hack Cecil..........	40	Dr	45.8	14	G	S,G	D,O(?)	N	NI	Tc	.6	29.90	8-23-50	Y300, P30.
11db2	.....do.............	41	Dr	52.7	20	G	S,G	D,O(?)	N	NI	Tc	.2	29.14	8-23-50	Y250, P30.
17dd	Walter Rudnik.......	50	Du	29.9	24	G	S	D(?)	N	NI	Tc	.0	17.14	8-15-50	Y100, P15, S.
18da	Wayne Ritz..........	49	Dr	37.2	24	S	S	D(?)	T,T	I	Tpb	.1	22.11	8-18-50	Y350, A20, S.
23da	Charles Romine......	46	Du	33.6	72-21	C	S	A,O(?)	C,G	I	Stp	2.0	20.74	7-11-50	Y2.
24ac	Archie Lohman.......	49	Dr	52	18	S	S,G	D,O(?)	T,G	I	Ls	....	25	8-17-50	Y1,213M, D5, A90, S.
25ab	Ed Galbreath........	47	Dr	24	24	G	S,G	A	C,T	I	Tc	.3	11.22	8-17-50	Y465M, A25, S.
25ad	Cecil Williams......	49	Dr	17.1	18	G	S,G	A	C,T	I,O	Tc	.2	9.96	7-20-50	Y200, A16, S.
25ba	Mike Meade..........	45	Du	40.4	60-24	C,S	S,G	A,O(?)	C,G	I,O	Tc	.1	20.03	8-17-50	Y675M, D8, A60, S.
25bc	Melvin Williams.....	47	Dr	44.1	60-20	C,G	S,G	A,O(?)	T,G	I	Tc	.0	24.26	8-17-50	Y910M, D8, A70, S.
31dc	Lynn Laybourn.......	..	Dr	.....	.....	...	...	......	....	NI	....	....	......	8-18-50	
32cb	.....do.............	49	Dr	31	20	G	S,G	A	T,T	I	Ls	....	12	8-15-50	Y600, A50, S, X31.
33dd	E. H. Wiant.........	48	Dr	57	18	G	G	O	T,G	I	Ls	....	32	7-20-50	Y700, A140, S, X57.
34ac	Frank Heady.........	45	Dr	52	18	G	S,G	A,O	T,T	I	Bpb	.8	13.57	8-23-50	Y800, A35, X52.

50-25dd	Mr. Hagerson........	..	Dr	32.6	5	G	...	......	N	O	Tc	.8	29.89	7- 3-50
36ca	Glade Stansfield....	..	Dr	44.9	.....	...	S,G	O	T,T	I	Tpb	.7	30.76	7-19-50 S.
C 5-49- 2bb	....	..	Dr	48.7	5	G	...	......	N	O	Tc	.1	38.92	8-15-50
4aa	B. R. Rapp..........	50	DD	56	18	S	G	O	T,T	I	Tc	.5	36.14	7-19-50 Y750, A40, S.
4ba	Glade Stansfield....	..	Dr	.....	18	G	S,G	O	T,D	I	Tc	.6	33.04	7-19-50
4bb	Fred Laybourn.......	50	Dr	77.2	18	S	S,G	O	N	NI	Tc	.4	38.67	8-18-50 Y1,150, P160, L, S.
4bd	B. R. Rapp..........	41	DD	61	36-18	C,G	S,G	O	T,T	I	Tpb	.5	35.87	7-19-50 Y1,250, A40, S, X91.
5aa	Glade Stansfield....	..	Dr	.....	18	G	S,G	O	N	NI	Tc	.3	37.25	8-18-50
5ab	Fred Laybourn.......	50	Dr	31.8	24	G	S,G	A,O	N	NI	Tc	.8	9.15	8-23-50 Y400.
7aa	....	..	Dr	92.3	5	G	...	......	N	O	Tc	.4	71.29	8-17-50
50- 2aa	Lloyd McIrvin.......	40	DD	54	24	G	G	O	T,G	I,O	Tc	1.8	21.81	7-19-50 Y600, D10, A50, S.
2bb	Joseph Hartzman.....	48	DD	58.4	18	G	S,G	O	T,G	I	Tpb	1.3	39.29	7-19-50 Y688M, X54.
2cc	Carl Mumme..........	..	DD	.....	.....	...	S,G	A,O(?)	N	NI	....	....	......	8- 1-50
3bb1	Joseph Hartzman.....	..	DD	49	18	G	S,G	O	T,G	I	Ls	....	39	7-20-50 Y420M, X50.
3bb2	.....do.............	..	Dr	56	18	G	S,G	O	T,G	I	Tpb	.0	38.77	7-20-50
3cb	Ezra Page...........	50	Dr	50	20	G	S,G	O	T,T	I	Bpb	.1	32.84	7-20-50 Y521M, P60, S.
3db	Carl Mumme..........	48	Dr	50.4	18	S	S,G	A,O(?)	N	NI	Tc	.0	29.76	8- 1-50 Y600, X47.
3dc1	.....do.............	44	Du	50.4	32	W	S,G	A,O(?)	T,T	I	Tpb	1.0	32.76	7-26-50 Y900, X51.
3dc2	.....do.............	..	DD	.....	.....	N	S,G	A,O(?)	N	NI	....	....	......	8- 1-50
4aa	H. W. Drullinger....	49	Dr	47.7	18	G	S,G	A,O(?)	T,T	I	Tc	.3	32.22	8- 1-50 Y300, S.
6dd	....	..	..	.....	30-18	C	...	......	N	O	Tc	.4	59.92	7-25-50
10ba	Oscar Higgason......	48	Dr	47	18	G	S,G	A	T,T	I	Ls	....	24	8-23-50 Y300, A25, S.
51-21dd	R. Clinkenbeard.....	50	Dr	50	18	G	S,G	A,O(?)	T,T	I	Tpb	.0	20.54	10-16-50 Y895M, D28, A30, S.
22ac	.....do.............	50	Dr	13.5	24	G	S	A	T,T	I	....	....	......	8-28-50 Y650, A35, S.
22ca1	Carl Mumme..........	47	Dr	55.4	20	S	S,G	A,O(?)	T,T	I	Tc	-1.4	28.10	8-24-50 Y694M, X51.
22ca2	.....do.............	40	Dr	28.3	60	C	S,G	A,O(?)	N	NI	Twc	.3	26.65	8-24-50 X47.
22ca3	.....do.............	48	Dr	49.6	24	S	S,G	A,O(?)	T,T	I	Tc	.2	25.27	8-24-50 Y800, D20, A60, S, X49.
22ca4	.....do.............	47	Dr	51.3	18	G	S,G	A,O(?)	T,T	I	Tc	.0	27.39	8-24-50 Y630M, A60, S, X49.
22da	.....do.............	46	Dr	56	18	S	S,G	A,O(?)	T,T	I	Tc	.1	27.39	7-28-50 Y950, A40, X55.
22db	.....do.............	50	Dr	56.1	24	G	S,G	A,O(?)	T,T	I	Tc	.0	26.40	7-25-50 Y284M, A40.
22dd1	.....do.............	49	Dr	52.3	18	G	S,G	A,O(?)	T,T	I	Tpb	.6	18.09	7-26-50 Y935M, A75, S.
22dd2	.....do.............	49	Dr	65.0	18	G	S,G	A,O(?)	N	NI	Tc	.6	48.46	7-28-50
23cb	Francis Wrape.......	49	Dr	52.3	18	G	S,G	A,O(?)	T,T	I,O	Tpb	.6	18.09	7-26-50 Y935M, A75, S.
23cc	.....do.............	41	Du	66	60-24	C,S	S,G	A,O(?)	T,T	I	Tpb	.7	37.03	7-26-50 Y450, A30.
23da	.....do.............	49	Dr	52.3	18	G	S,G	A,O(?)	T,T	I	Tc	1.0	26.44	7-26-50 Y428M, A30, S.

Table 1.--Records of wells in the Kansas River basin in eastern Colorado--Continued

Well no.	Owner	Year drilled, 19--	Type of well	Depth of well (feet)	Diameter of well (inches)	Type of casing	Principal water-bearing bed: Character of material	Principal water-bearing bed: Geologic source	Method of lift and type of power	Use of well	Measuring point: Description	Measuring point: Distance above or below (-) land surface (feet)	Depth to water level below measuring point (feet)	Date of record	Remarks
							Washington County--Continued								
C 5-51-28da	Carl Mumme..........	..	Dr	33	18	S	S,G	A,O(?)	N	NI	....	....	......	8- 1-50	Y300.
29cc	Everett & Chill Lomas.	40	Du	57.1	20	S	S,G	O	T,T	I	Twc	0.8	37.19	8-25-50	Y1,000, D25, A70.
32ad	E. V. Holden........	40	Du	46	18	G	G	O	T,T	I	Ls	....	18	8-25-50	Y800, D21, A15.
32ca	Everett & Chill Lomas.	37	Du	51	84	C	S,G	O	N	NI	Ls	....	26	8-25-50	Y1,000, D18, P85.
33bd	Carl Mumme..........	48	Dr	57	18	G	S,G	A,O(?)	T,N	I	Bpb	.0	36.05	7-26-50	Y400.
							Yuma County								
B 1-43- 6bc	Town of Wray........	21	Du	76	18	C	S	A	T,E	P	Ls	....	60	9-12-50	Y150, D15, L.
6bd1	.....do.............	28	Du	75	4	S	S,G	A	T,E	P	Ls	....	60	9-12-50	Y97, D17.
6bd2	.....do.............	28	Du	75	4	S	S,G	A	T,E	P	Ls	....	60	9-12-50	Y150, D15.
6bd3	.....do.............	28	Du	75	8	S	S,G	A	T,E	P	Ls	....	60	9-12-50	Y250, D15.
6bd4	.....do.............	28	Du	75	4	S	S,G	A	T,E	P	Ls	....	60	9-12-50	Y150, D15.
45-33ad	Clarence Stults.....	49	Dr	145	18	G	S,G	O	T,T	I	Bpb	.0	41.55	3-13-51	Y750, D26, A50, S.
B 2-42-34cc	E. H. Kinnie........	49	Dr	64.6	18	S	S,G	O	T,G	I	Bpb	1.7	24.77	9-12-50	Y750, D18, A90, L, S, X65.
46-26bc	Town of Eckley......	21	DD	317	6	S	S,G	O	T,E	P	Ls	....	45	9-11-50	Y200, D2.
48-15dd	L. E. Fitzgerald....	50	Dr	240	5.5	G	S,G	O	J,E	I	Ls	....	190	3-13-51	Y13, D3, L.
22ac1	Town of Yuma........	20	Du	320	96-6	C,S	S,G	O	T,E	P	Ls	....	180	9- 9-50	Y300, D9, L.

22ac2	.....do.............	42	Dr	310	18	S	S,G	O	T,E	P	Ls	....	180	9- 9-50	Y500, D12
B 4-44-36cb	Harry Bledsoe, Jr...	49	Dr	98	18	S	S,G	O	T,B	I,O	Bcop	1.2	31.88	10- 2-50	Y700, D56, A100, L, S.
B 5-42-18bc	Ivan Leach..........	..	..	65	24	G	S,G	D,O(?)	T,E	I	Tc	-7.0	3.89	9-26-50	Y110, A20, S.
43-24ab	E. H. Kinnie........	47	Dr	260	18	S	S,G	O	T,G	I	Tc	.3	16.13	9-26-50	Y1,650, D19, A120, L.
C 4-42-32da	Mr. Wiley...........	..	..	.....	.....	...	...	......	T,B	I	Bpb	.5	32.96	4-19-51	
44- 5dd	Gerald Zion.........	50	Dr	325	16	S	S,G	O	N	NI	Tc	1.0	231.24	10-21-50	Y1,000, D17, L, X332.
10dd	Charles Sheverbush..	50	Dr	326	18	G	G	O	T,D	I	Ls	....	204	7-18-50	Y1,190M, D47, L, X341.
47-25dc	David Idler.........	51	Dr	259	10	G	S,G	O	T,B	I	Tah	.6	105.70	3-15-51	Y700, D10, A80, L, S.
31ab	Edgar Fadenrecht....	49	Dr	178.6	16	G	G	O	T,T	I	Bpb	.4	89.04	7-18-50	Y810M, D30, A50, S, X178.
48-19cb	Ed Galbreath........	50	Dr	38.8	24	G	S,G	A	N	NI	Tc	1.5	13.86	8-17-50	Y927M, D8, P50.
20ab	Hack Cecil..........	47	DD	28.4	18	G	S,G	A	T,T	I	Tah	.4	7.00	8-23-50	Y1,500, D16, A80, S.
C 5-42- 8dc	Ted Yenter..........	47	Dr	59.8	18	G	S,G	O	T,D	I	Tc	1.0	20.65	7-17-50	Y500, D37, A80, S, X63.
17ab	.....do.............	47	Dr	73	8	I	S,G	O	T,T	I	Ls	....	28	7-17-50	Y125, D37, X73.
43-12ba	Roscoe Hutton.......	40	Du	70	36	G	S,G	O	T,T	I	Tpb	3.2	14.32	7-17-50	Y900, S, X70.
14ac	Alfred Schnase......	45	Dr	101	18	S	S,G	O	T,D	I	Ls	....	32	7-17-50	Y900M, D30, A90, X98.
44-23dd	J. C. Lengle........	50	Dr	80	18	G	S,G	O	T,G	I,O	Tc	.0	28.73	7-17-50	Y950M, D50, P150, L, X75.
30bb	Emmet Bennet........	48	Dr	86.2	24	G	G	O	T,T	I	Tc	1.1	24.42	8-30-50	Y1,500M, D19, A56, L, S.
45- 4ba	Ernest Romke........	37	Dr	208	12	G	S,G	O	T,G	I	Ls	....	180	8-28-50	Y300, D7.5, A25.
47- 4ba	Oscar Cox...........	50	Dr	176	24-16	S	G	O	T,T	I	Ls	....	100	7-18-50	Y450, D20, A28, P240, L, S.
15cd	C. R. Darling.......	37	DD	285	30-14	C,G	S,G	O	T,G	I	Ls	....	110	7- 3-50	Y344M, D10, A40, S.
16ad	O. E. Gurss.........	49	Dr	215	18	G	S,G	O	T,D	I	Ls	....	107	7-18-50	Y1,350, D60, A800, L, S.
22ab	....	..	Dr	149.8	5	G	...	......	N	S	Tc	.5	107.04	7- 3-50	
48-25ab	Albert Packer.......	40	Dr	159.5	14	G	S,G	O	T,T	I	Tc	.0	121.40	8-15-50	Y700, D15, P160, S, X160.

LOGS OF TEST HOLES, SEISMOGRAPH SHOT HOLES, AND WELLS

The logs of 329 test holes, seismograph shot holes, and wells are presented in numerical order within counties on the following pages.

Well B8-47-29aa, a public-supply well for Haxtun, was drilled by L. L. Canfield in 1948; the log of the well cuttings was prepared by J. A. Tavelli of the U. S. Geological Survey. All of the other logs are drillers' logs. The logs of seismograph shot holes are of questionable value in subdividing lithologic units; their principal value is that they record where the top of the Pierre shale was reached.

The term "caliche" is substituted for "magnesia", "magnesia rock", "gyp rock", "lime", and "limestone", which are terms used by the drillers to describe certain calcareous beds. The term "sandstone" is used here as a substitute for the drillers' terms "sandstone", "sand rock", and "sandyrock"; the term "sandstone" is used variously for all sandy rocks from hard "mortar beds" to fairly well compacted or cemented sand. Formational names have been added to the drillers' logs.

Table 2.--Logs of test holes, seismograph shot holes, and wells

Cheyenne County

	Thickness (feet)	Depth (feet)
C12-42-14dd		
Soil, sandy	5	5
Ogallala formation:		
Sand, containing clay breaks	60	65
Rock	3	68
Sand, interbedded with clay	78	146
Sand (water)	4	150
Pierre shale:		
Shale, blue	...	150

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Cheyenne County--Continued

	Thickness (feet)	Depth (feet)
C12-42-22. (South half of section)		
Soil	15	15
Ogallala formation:		
Rock	65	80
Sand	6	86
Rock	44	130
Sand	8	138
Rock	27	165
Sand (water)	10	175
Pierre shale:		
Shale	...	175
C12-44-6. (West half of section)		
Ogallala formation:		
Clay with some streaks of sand	140	140
Soapstone, fairly soft	10	150
Gravel (water)	8	158
Pierre shale:		
Shale	...	158
C13-42-6bc. Drilled by John Snyder, 1949		
Soil	8	8
Soil, sandy	7	15
Ogallala formation:		
Clay and sand	15	30
Sand, good (water)	18	48
Clay and gravel	22	70
Gravel (water)	10	80
Sandstone	2	82
C13-43-24a		
Soil	4	4
Ogallala formation:		
Sand, alternating with clay	196	200
Rock	2	202
Sand, alternating with clay	66	268
Sand (water)	2	270
Pierre shale:		
Shale, blue	...	270

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Cheyenne County--Continued

	Thickness (feet)	Depth (feet)
C14-42-30a		
Ogallala formation:		
Clay..................	80	80
Sand and gravel........	125	205
Gravel (water).........	39	244
Pierre shale:		
Shale, blue...........	1	245
C14-43-12b		
Ogallala formation:		
Sand and clay..........	(?)	(?)
Gravel, coarse.........	(?)	240
Gravel (water).........	10	250
Pierre shale:		
Shale, blue...........	...	250
C14-44-20ad. Drilled by Allied Wells Co.		
Ogallala formation:		
Clay, sandy...........	9	9
Sand..................	16	25
Clay, sandy...........	13	38
Sand and rock..........	80	118
Clay..................	14	132
Caliche...............	7	139
Clay and sand..........	11	150
Sand and caliche, hard.	8	158
Caliche, hard..........	9	167
Clay..................	18	185
Clay, sandy...........	33	218
Clay..................	14	232
Sand, coarse..........	7	239
Clay..................	5	244
Sand..................	8	252
Pierre shale:		
Shale.................	63	315
Rock..................	2	317
Shale.................	3	320
Rock and shale.........	25	345
Clay..................	19	364
Shale.................	22	386
Shale, hard...........	6	392
Clay..................	8	400
Shale.................	100	500

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Cheyenne County--Continued

	Thickness (feet)	Depth (feet)
C14-44-20dc2. Drilled by Jack Doty, 1949		
Soil....................	15	15
Ogallala formation:		
Clay, sandy...........	10	25
Clay..................	10	35
Clay, firm, sticky.....	10	45
Clay..................	5	50
Clay, sandy...........	5	55
Sand..................	15	70
Clay, sandy...........	15	85
Clay..................	30	115
Clay, sandy...........	5	120
Clay..................	15	135
Clay, sandy...........	20	155
Clay..................	5	160
Sand..................	15	175
Sand and clay..........	20	195
Clay..................	15	210
Sand and clay..........	5	215
Gravel, coarse.........	24	239
Sand..................	6	245
Gravel................	30	275
Sand..................	85	360
C14-44-20dc3. Drilled by Otis Shuck, 1946		
Soil, sandy.............	10	10
Ogallala formation:		
Clay, sandy...........	10	20
Clay and caliche.......	40	60
Sand and clay..........	40	100
Sand, fine............	20	120
Clay..................	10	130
Sand, coarse, and gravel...............	10	140
Sand and gravel........	10	150
Sand, fine............	30	180
Sand, medium..........	10	190
Rock, hard, and gravel.	10	200
Rock..................	10	210
Clay and rock..........	10	220
Rock..................	10	230
Sand, compact; gravel, and rock..............	10	240

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Cheyenne County--Continued

	Thickness (feet)	Depth (feet)
C14-44-20dc3--Continued		
Ogallala formation--Con.		
Clay	5	245
Clay, soft	10	255
Sand (water)	15	270
Clay	10	280
Sand (water)	10	290
Sand, fine	10	300
Sand, fine, containing some clay	30	330
Clay, compact	5	335
Sand, good (water)	10	345
Pierre shale:		
Shale, yellow and green	10	355
C15-42-25c		
Ogallala formation:		
Clay, containing a little sand	175	175
Quicksand, very wet	1	176
Clay	29	205
Sand, fine (water)	5	210
Pierre shale:		
Shale, blue	...	210
C15-44-5		
Soil	4	4
Ogallala formation:		
Caliche	2	6
Clay, sandy	209	215
Quicksand	45	260
Rock	5	265
Gravel, coarse (water)	5	270
Pierre shale:		
Shale, blue	...	270

Kit Carson County

	Thickness (feet)	Depth (feet)
C6-45-3ab. Drilled by K. G. Wilcox, 1948		
Soil, clayey	17	17
Alluvium(?):		
Clay, containing strips of gravel	3	20
Gravel, coarse	12	32

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C6-45-3ab--Continued		
Alluvium(?)--Con.		
Caliche	5	37
Caliche, hard	3.5	40.5
Gravel, coarse	15.5	56
Ogallala formation(?):		
Caliche	2.5	58.5
Clay, yellow	1.5	60
Caliche, hard	2	62
Clay, yellow	1	63
Gravel, coarse, very loose	16	79
Clay	5	84
Gravel, coarse, very loose	2	86
Clay	7	93
Gravel	8	101
Pierre shale(?):		
Shale	.....	101
C6-46-27da. Drilled by K. G. Wilcox, 1950		
Soil	9	9
Alluvium:		
Gravel, loose	5	14
Clay, white	4	18
Gravel	14	32
Gravel, coarse, very loose	8	40
Ogallala formation:		
Clay, yellow	3	43
Clay, sandy	9	52
Sand, fine, compact	13	65
Conglomerate, soft	8	73
Gravel, coarse, loose	2	75
Clay	5	80
Sand, fine	3	83
Gravel, loose	10	93
Clay	1	94
Pierre shale(?):		
Shale	2	96
C6-50-6bb		
Ogallala formation:		
Clay	40	40
Gravel and sand	50	90
(No sample)	10	100
Sand	40	140
Clay, yellow	25	165

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C6-50-6bb--Continued		
Pierre shale:		
Shale, blue	5	170
C6-50-29cc. Drilled by Ben Hasz, 1948		
Soil	8	8
Ogallala formation:		
Sand, containing strips of caliche	123	131
Caliche, containing strips of sand	10	141
Sand, loose	5	146
Caliche and sand	1	147
Sand, loose	2	149
Clay, sandy	3	152
Gravel, loose	8	160
Clay, yellow	7	167
Pierre shale(?):		
Shale	...	167
C6-50-30bd. Drilled by Ben Hasz, 1948		
Soil	4	4
Ogallala formation:		
Sand	21	25
Clay, sandy, and sandstone	22	47
Sand, with some caliche	17	64
Sand, caliche, and clay	23	87
Caliche and clay	18	105
Clay, sandy, and caliche	7	112
Sand, with some clay	15	127
Clay, sandy, and caliche; contains some sandstone	25	152
Sand, tight, and caliche	5	157
Clay	10	167
Sand, fairly loose, containing strips of clay	21	188
Sand, loose	10	198
Clay, yellow	8	206
Pierre shale(?):		
Shale	...	206

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C6-51-6bb		
Ogallala formation:		
Clay	40	40
Gravel and sand	50	90
Caliche	10	100
Sand	40	140
Clay, yellow	15	155
Pierre shale:		
Shale, blue	5	160
C7-42-15dd		
Silt	10	10
Ogallala formation:		
Clay, sandy	50	60
Gravel	60	120
Sand, containing small breaks of caliche	80	200
Sand, with streaks of clay	110	310
Pierre shale:		
Shale, blue	10	320
C7-43-16dd		
Silt	10	10
Ogallala formation:		
Clay, sandy	50	60
Gravel	40	100
Gravel, with small breaks of caliche	180	280
Sand and clay	22	302
Pierre shale:		
Shale, blue	8	310
C7-44-16d		
Ogallala formation:		
Sand and streaks of gravel and caliche	195	195
Clay, yellow	10	205
Pierre shale:		
Shale, blue	15	220
C7-44-31cc. Altitude, 4,157 feet		
Ogallala formation:		
Clay	20	20
Gravel	30	50
Clay and caliche	140	190
Gravel	75	265

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C7-44-31cc--Continued		
Pierre shale:		
Shale, blue	5	270
C7-45-21aa		
Ogallala formation:		
Clay and caliche	140	140
Clay, caliche, and breaks of marl	175	315
Pierre shale:		
Shale, blue	15	330
C7-45-29ac. Drilled by K. G. Wilcox, 1950		
Soil	52	52
Ogallala formation:		
Caliche, hard, blocky	2	54
Caliche, compact, and strips of clay	38	92
Gravel, fine, compact	2	94
Gravel, coarse, very compact	2	96
Gravel, very coarse, and hard blocky caliche	3	99
Caliche and sandy compact clay	1	100
Caliche, soft, and strips of sand	7	107
Caliche, hard	4	111
Caliche, blocky, and very coarse gravel	12	123
Clay	4	127
Gravel, coarse, compact	9	136
Gravel, coarse	7	143
Sandstone	7	150
Clay	7	157
Caliche	3	160
Gravel, coarse, loose, and soft clay	11	171
Clay and very coarse gravel	8	179
Caliche and very coarse gravel	7	186
Clay, sandy	6	192
Clay	3	195
Caliche, hard	3	198
Clay, sandy	2	200

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C7-45-29ac--Continued		
Ogallala formation--Con.		
Gravel and strips of clay	6	206
Gravel	3	209
Clay, yellow, and strips of white clay	7	216
Clay, sandy	16	232
Gravel	4	236
Clay, white	6	242
Gravel, coarse	2	244
Sand	10	254
Gravel, very coarse, and sand	1	255
Gravel and clay	5	260
Gravel, very coarse, and sand	18	278
Gravel and clay	3	281
Conglomerate, hard, blocky	1	282
Clay, white	3	285
Gravel, fine, loose	3	288
Clay, sandy	1	289
Sand	7	296
Clay	6	302
Sand	5	307
Gravel	3	310
Pierre shale(?):		
Shale	2	312
C7-46-16dd		
Ogallala formation:		
Clay and caliche, with small breaks of gravel	190	190
Clay, yellow	25	215
Pierre shale:		
Shale, blue	15	230
C7-47-24. (North half of section)		
Soil	3	3
Ogallala formation:		
Clay and caliche	165	168
Gravel	22	190
Pierre shale:		
Shale	...	190

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C7-49-31a		
Soil	5	5
Ogallala formation:		
Clay and caliche	174	179
Gravel (water)	5	184
Pierre shale:		
Shale	...	184
C7-51-1aa		
Ogallala formation:		
Clay	40	40
Gravel and sand	110	150
Clay, yellow	15	165
Pierre shale:		
Shale, blue	5	170
C7-51-21aa		
Ogallala formation:		
Gravel	25	25
Sand	75	100
Caliche	15	115
Clay, yellow	15	130
Pierre shale:		
Shale, blue	10	140
C8-42-7dd. Altitude, 4,000 feet		
Ogallala formation:		
Clay	60	60
Gravel	40	100
Clay and caliche; contains breaks of gravel	220	320
Clay, gray	5	325
Pierre shale:		
Shale, blue	15	340
C8-42-18ad. Altitude, 4,011 feet		
Ogallala formation:		
Clay, sandy	50	50
Sand and gravel	250	300
Sand, fine	40	340
Pierre shale:		
Shale, blue	20	360

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-42-18cc. Altitude, 4,026 feet		
Ogallala formation:		
Clay	40	40
Gravel	120	160
Clay and caliche; contains small breaks of gravel	90	250
Sand	75	325
Pierre shale:		
Shale, blue	15	340
C8-42-18cd. Altitude, 4,024 feet		
Ogallala formation:		
Clay sandy	30	30
(No sample)	15	45
Sand and gravel	155	200
Sand	130	330
Pierre shale:		
Shale, blue	20	350
C8-42-18da. Altitude, 4,008 feet		
Ogallala formation:		
Clay and caliche; contains small breaks of gravel	250	250
Sand	70	320
Clay, yellow	15	335
Pierre shale:		
Shale, blue	5	340
C8-42-18dc. Altitude, 4,015 feet		
Ogallala formation:		
Clay	50	50
Clay and caliche; contains breaks of gravel	200	250
Sand	60	310
Clay, gray	20	330
Pierre shale:		
Shale, blue	10	340

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-42-20aa. Altitude, 3,985 feet		
Ogallala formation:		
Clay..................	60	60
Sand and caliche; contains streaks of gravel....................	130	190
Clay, containing strips of sand...............	90	280
Pierre shale:		
Shale, blue............	20	300
C8-42-20ab. Altitude, 3,987 feet		
Ogallala formation:		
Clay, sandy............	55	55
Sand..................	45	100
Sand and gravel........	160	260
Shale, gray............	20	280
Pierre shale:		
Shale, blue............	20	300
C8-42-20ba. Altitude, 3,995 feet		
Ogallala formation:		
Clay..................	60	60
Sand and gravel streaks..............	140	200
Sand..................	105	305
Pierre shale:		
Shale, blue............	15	320
C8-42-20bb. Altitude, 4,011 feet		
Ogallala formation:		
Clay, sandy............	50	50
Sand and gravel........	280	330
Pierre shale:		
Shale, blue............	20	350
C8-42-20bc. Altitude, 4,001 feet		
Ogallala formation:		
Clay and caliche.......	70	70
Sand and gravel........	180	250
Clay, yellow...........	15	265
Pierre shale:		
Shale, blue............	15	280

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-42-20cb. Altitude, 3,999 feet		
Ogallala formation:		
Clay, sandy............	50	50
Sand and gravel........	150	200
Sand..................	50	250
Shale, gray............	10	260
Pierre shale:		
Shale, blue............	20	280
C8-42-20cc. Altitude, 3,996 feet		
Ogallala formation:		
Clay..................	70	70
Gravel.................	20	90
Clay and caliche, with breaks of sand........	160	250
Clay, yellow...........	15	265
Pierre shale:		
Shale, blue............	15	280
C8-43-22bb		
Ogallala formation:		
Clay, sandy............	40	40
Sand and gravel........	160	200
Clay, sandy............	110	310
Pierre shale:		
Shale, blue............	10	320
C8-44-22bb		
Ogallala formation:		
Clay, sandy............	50	50
Clay and caliche.......	200	250
Sand..................	75	325
Pierre shale:		
Shale, blue............	15	340
C8-44-36cd. Drilled by K. G. Wilcox, 1948		
Soil....................	5	5
Ogallala formation:		
Clay, yellow...........	31	36
Caliche, soft..........	14	50
Gravel, containing strips of hard rock...	19	69
Caliche, hard..........	4	73

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-44-36cd--Continued		
Ogallala formation--Con.		
Clay, sandy	4	77
Caliche, hard	1	78
Clay, sandy	8	86
Conglomerate	8	94
Gravel, containing strips of hard rock	9	103
Clay, sandy	6	109
Gravel	7	116
Clay, sandy	6	122
Conglomerate	9	131
Clay, containing strips of hard rock	11	142
Caliche, hard, and clay	14	156
Caliche, hard	8	164
Gravel, coarse	6	170
Rock, hard	4	174
Clay, sandy, containing strips of hard rock	7	181
Conglomerate	4	185
Caliche, hard	15	200
Sand, fine	2	202
Sandstone, hard	5	207
Sand, fine	1	208
Sandstone, hard	1	209
Sand, fine	1	210
Sandstone, hard	4	214
Sandstone, containing strips of clay and sand	10	224
Clay, brown	17	241
Clay, containing strips of sand and rock	18	259
Sand, fine	6	265
Sand, fine, containing strips of clay and rock	29	294
Joint clay, brown	4	298
Sand, fine	7	305
Sand, fine, and strips of clay	16	321
Gravel	15	336
Joint clay and strips of gravel	11	347
Pierre shale:		
Shale, blue	3	350

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-44-36db. Dug by Kelly Well Co. Inc., 1928		
Ogallala formation:		
Clay, light-colored	38	38
Caliche, hard, and clay	3	41
Clay	15	56
Sand, cemented, and cobbles of caliche	7	63
Sand, soft	30	93
Caliche, hard	2	95
Sand, cemented	6	101
Gravel, coarse	3	104
Gravel, cemented, and rock	5	109
Clay and rock	1	110
Sand, fine	3.5	113.5
Caliche, hard	3.5	117
Clay	1.5	118.5
Caliche, hard	3.5	122
Clay	1	123
Sand	6	129
Clay, sandy	1	130
Sandstone, hard	46	176
Caliche, hard	2	178
Sand, coarse	2	180
Sandstone	12	192
Rock, clay, and sand	8	200
Sand and clay	2	202
Sand and rock	2	204
Rock, containing strips of sand (well plugged back to 230 feet)	26	230
Gravel and clay	4	234
Clay	44	278
Shale	15	293
Sand and clay	6	299
Sand, fine, and clay	23	322
Sand and clay	12	334
Sand and gravel	1	335
Sand and clay	6	341
Pierre shale:		
Shale, blue	5	346
C8-45-3c. Altitude, 4,179 feet		
Ogallala formation:		
Clay	40	40
Gravel	30	70

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-45-3c--Continued		
Ogallala formation--Con.		
Clay and caliche	110	180
Gravel	40	220
Clay, yellow	10	230
Pierre shale:		
Shale, blue	10	240
C8-45-4bb. Altitude, 4,232 feet		
Ogallala formation:		
Clay	40	40
Gravel	30	70
Clay and caliche	120	190
Gravel	100	290
Clay, gray	10	300
Pierre shale:		
Shale, blue	10	310
C8-45-5dd. Altitude, 4,170 feet		
Ogallala formation:		
Clay	40	40
Gravel	40	80
Clay and caliche	80	160
Gravel	40	200
Clay, gray	10	210
Pierre shale:		
Shale, blue	10	220
C8-45-6cc. Altitude, 4,215 feet		
Ogallala formation:		
Sand	30	30
Gravel and sand	40	70
Caliche	20	90
Gravel	30	120
Shale	25	145
Sand and gravel	45	190
Pierre shale:		
Shale, blue	...	190
C8-45-10cc. Altitude, 4,159 feet		
Silt	30	30
Ogallala formation:		
Gravel	40	70
Sand and streaks of caliche	100	170
Shale, gray	15	185
Pierre shale:		
Shale, blue	15	200

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-45-13cc. Altitude, 4,209 feet		
Ogallala formation:		
Clay	40	40
Gravel	50	90
Clay and caliche	100	190
Gravel	45	235
Clay, yellow	10	245
Pierre shale:		
Shale, blue	5	250
C8-45-13d. Altitude, 4,157 feet		
Ogallala formation:		
Sand	20	20
Gravel	30	50
Caliche	70	120
Shale, sandy, and gravel	60	180
Caliche	40	220
Pierre shale:		
Shale, blue	...	220
C8-45-14a. Altitude, 4,206 feet		
Ogallala formation:		
Clay	40	40
Gravel	40	80
Clay and caliche	100	180
Caliche	55	235
Gravel	10	245
Clay, yellow	5	250
Pierre shale:		
Shale, blue	...	250
C8-45-15aa. Altitude, 4,175 feet		
Ogallala formation:		
Clay	5	5
Gravel	30	35
Clay and caliche; contains breaks of gravel	175	210
Clay, yellow	10	220
Pierre shale:		
Shale, blue	...	220
C8-45-15dd. Altitude, 4,219 feet		
Ogallala formation:		
Clay, sandy	35	35
Sand and gravel	65	100
Clay, sandy	150	250

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-45-15dd--Continued		
Pierre shale:		
Shale, blue	10	260
C8-45-16cc. Altitude, 4,152 feet		
Ogallala formation:		
Gravel	15	15
Clay and caliche, with breaks of gravel	130	145
Clay, yellow	13	158
Pierre shale:		
Shale, blue	12	170
C8-45-17cc. Altitude, 4,234 feet		
Ogallala formation:		
Clay	15	15
Gravel	25	40
Clay and caliche	120	160
Gravel	50	210
Clay, yellow	10	220
Pierre shale:		
Shale, blue	10	230
C8-45-21cc. Altitude, 4,214 feet		
Ogallala formation:		
Sand	30	30
Gravel	40	70
Caliche	22	92
Sand	8	100
Gravel	80	180
Shale	8	188
Pierre shale:		
Shale, blue	12	200
C8-45-22cc. Altitude, 4,197 feet		
Ogallala formation:		
Sand	30	30
Gravel and sand	20	50
Gravel and caliche	30	80
Caliche	20	100
Gravel and sand	75	175
Shale	10	185
Pierre shale:		
Shale, blue	15	200

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-45-26cc. Altitude, 4,232 feet		
Ogallala formation:		
Sand	30	30
Gravel	90	120
Shale, sandy, and gravel	120	240
Pierre shale:		
Shale, blue	15	255
C8-45-28cc. Altitude, 4,212 feet		
Ogallala formation:		
Clay	30	30
Gravel	30	60
Clay and caliche	80	140
Gravel	22	162
Clay, gray	8	170
Pierre shale:		
Shale, blue	10	180
C8-45-29bb. Altitude, 4,248 feet		
Ogallala formation:		
Sand	20	20
Caliche	40	60
Gravel	40	100
Gravel; contains caliche breaks	130	230
Pierre shale:		
Shale, blue	10	240
C8-45-34bb. Altitude, 4,245 feet		
Ogallala formation:		
Clay	30	30
Gravel	40	70
Clay and caliche	160	230
Pierre shale:		
Shale, blue	10	240
C8-45-36c. Altitude, 4,229 feet		
Ogallala formation:		
Clay	40	40
Gravel	40	80
Clay and caliche	90	170
Gravel	65	235
Clay, yellow	15	250
Pierre shale:		
Shale, blue	10	260

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-46-1aa. Altitude, 4,247 feet		
Ogallala formation:		
Clay and sand..........	45	45
Sand, containing streaks of gravel and caliche...............	155	200
Sand..................	75	275
Clay, yellow...........	10	285
Pierre shale:		
Shale, blue............	15	300
C8-46-1bb. Altitude, 4,284 feet		
Ogallala formation:		
Clay and caliche.......	140	140
Gravel, containing breaks of clay and caliche...............	155	295
Clay, gray.............	10	305
Pierre shale:		
Shale, blue............	5	310
C8-46-3a. Altitude, 4,271 feet		
Ogallala formation:		
Clay and caliche, with breaks of gravel......	230	230
Gravel.................	40	270
Clay, yellow...........	15	285
Pierre shale:		
Shale, blue............	15	300
C8-46-3bb. Altitude, 4,290 feet		
Ogallala formation:		
Clay...................	30	30
Clay and caliche, with breaks of gravel......	250	280
Clay, yellow...........	10	290
Pierre shale:		
Shale, blue............	10	300
C8-46-11aa. Altitude, 4,277 feet		
Clay.....................	35	35
Gravel...................	35	70
Clay and caliche.........	120	190
(No sample)..............	90	280
Clay, gray...............	10	290
Pierre shale:		
Shale, blue............	10	300

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-46-13aa. Altitude, 4,276 feet		
Ogallala formation:		
Sand and gravel streaks...............	90	90
Sand and gravel; contains streaks of caliche...................	110	200
Sand and gravel........	75	275
Pierre shale:		
Shale, blue............	15	290
C8-46-13bb. Altitude, 4,262 feet		
Ogallala formation:		
Clay...................	28	28
Gravel.................	32	60
Clay and caliche.......	130	190
Gravel.................	55	245
Clay, gray.............	5	250
Pierre shale:		
Shale, blue............	10	260
C8-46-15b. Altitude, 4,306 feet		
Ogallala formation:		
Clay and caliche.......	150	150
Gravel.................	45	195
Clay and caliche.......	55	250
Clay, yellow...........	10	260
Pierre shale:		
Shale, blue............	10	270
C8-46-15c. Altitude, 4,316 feet		
Ogallala formation:		
Clay, with breaks of gravel and caliche....	230	230
Sand...................	30	260
Pierre shale:		
Shale, blue............	10	270
C8-46-18dd. Altitude, 4,355 feet		
Ogallala formation:		
Clay and caliche, with breaks of gravel......	260	260
Clay, yellow...........	10	270
Pierre shale:		
Shale, blue............	10	280

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-46-22a. Altitude, 4,287 feet		
Ogallala formation:		
Clay	8	8
Gravel	22	30
Clay and caliche	150	180
(No sample)	45	225
Clay, yellow	5	230
Pierre shale:		
Shale, blue	10	240
C8-46-22c. Altitude, 4,337 feet		
Ogallala formation:		
Clay, sandy	60	60
Gravel and sand	70	130
Caliche	20	150
Sand	80	230
Clay, yellow	10	240
Pierre shale:		
Shale, blue	10	250
C8-46-22dd. Altitude, 4,325 feet		
Ogallala formation:		
Clay	60	60
Gravel	30	90
Sand and streaks of caliche and gravel	110	200
Sand	60	260
Clay, yellow	10	270
Pierre shale:		
Shale, blue	...	270
C8-46-24bb. Altitude, 4,268 feet		
Ogallala formation:		
Clay	20	20
Clay and caliche, with breaks of gravel	220	240
Pierre shale:		
Shale, blue	10	250
C8-46-25aa. Altitude, 4,248 feet		
Ogallala formation:		
Clay	20	20
Gravel	25	45
Clay and caliche	115	160
Gravel	40	200
Clay, gray	15	215

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-46-25aa--Continued		
Pierre shale:		
Shale, blue	15	230
C8-46-25bb. Altitude, 4,323 feet		
Ogallala formation:		
Clay	40	40
Gravel	30	70
Clay and caliche	155	225
Gravel	40	265
Pierre shale:		
Shale, blue	15	280
C8-46-25c. Altitude, 4,324 feet		
Ogallala formation:		
Clay	30	30
Gravel	28	58
Clay and caliche, with breaks of gravel	112	170
Gravel	80	250
Clay, gray	10	260
Pierre shale:		
Shale, blue	10	270
C8-46-25dd. Altitude, 4,285 feet		
Ogallala formation:		
Clay	15	15
Gravel	35	50
Clay and caliche	110	160
Gravel	40	200
Clay, gray	15	215
Pierre shale:		
Shale, blue	5	220
C8-46-34b. Altitude, 4,354 feet		
Silt	10	10
Ogallala formation:		
Caliche	20	30
Sand and gravel	65	95
Clay, sandy	40	135
Sand and gravel; contains small breaks of caliche	65	200
Sand	60	260
Pierre shale:		
Shale, blue	10	270

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-46-35bb. Altitude, 4,319 feet		
Ogallala formation:		
Clay, sandy	40	40
Sand and gravel	55	95
Sand, with slight breaks of caliche	40	135
Sand and gravel	65	200
Sand	30	230
Shale, gray	10	240
Pierre shale:		
Shale, blue	10	250
C8-47-1c		
Soil	5	5
Ogallala formation:		
Clay, caliche, and gravel	102	107
Gravel (water)	11	118
Pierre shale:		
Shale	...	118
C8-47-4aa		
Ogallala formation:		
Clay, with breaks of gravel	270	270
Clay, yellow	20	290
Pierre shale:		
Shale, blue	10	300
C8-47-10aa		
Ogallala formation:		
Clay	10	10
Gravel	10	20
Clay	10	30
Sand and streaks of sandy shale	90	120
Clay, yellow	25	145
Pierre shale:		
Shale, blue	15	160
C8-47-11aa		
Ogallala formation:		
Clay and breaks of gravel	134	134
Clay, yellow	21	155
Pierre shale:		
Shale, blue	5	160

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-47-14dd		
Ogallala formation:		
Clay	30	30
Gravel	10	40
Sand	50	90
Gravel and sand	30	120
Shale, sandy	15	135
Clay, yellow	23	158
Pierre shale:		
Shale, blue	2	160
C8-47-17aa		
Ogallala formation:		
Sand	105	105
Shale, sandy	15	120
Clay, yellow	20	140
Shale, gray	13	153
Pierre shale:		
Shale, blue	7	160
C8-47-19dd		
Ogallala formation:		
Sand and gravel	50	50
Clay and caliche	60	110
Clay, yellow	23	133
Pierre shale:		
Shale, blue	7	140
C8-47-21dd		
Ogallala formation:		
Clay and breaks of gravel	118	118
Clay, yellow	14	132
Pierre shale:		
Shale, blue	9	141
C8-47-26bb		
Ogallala formation:		
Sand	50	50
Shale, sandy	20	70
Sand and gravel	40	110
Clay, yellow	10	120
Pierre shale:		
Shale, blue	10	130

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-47-26c		
Ogallala formation:		
Sand, gravel, and caliche	60	60
Sand	30	90
Clay, yellow	15	105
Pierre shale:		
Shale, blue	15	120
C8-47-28cc		
Ogallala formation:		
Sand	70	70
Gravel	15	85
Sand	25	110
Shale, sandy	10	120
Clay, yellow	20	140
Pierre shale:		
Shale, blue	10	150
C8-47-28d		
Ogallala formation:		
Clay and sand	120	120
Clay, yellow	12	132
Pierre shale:		
Shale, blue	9	141
C8-48-24aa		
Ogallala formation:		
Sand and sandy shale	109	109
Clay, yellow, and gray shale	21	130
Pierre shale:		
Shale, blue	10	140
C8-58-24d		
Ogallala formation:		
Sand and sandy shale; contains streaks of caliche	60	60
Clay, yellow	30	90
Shale, gray	10	100
Pierre shale:		
Shale, blue	20	120

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-48-28aa		
Ogallala formation:		
Clay	20	20
Gravel	20	40
Sand	70	110
Caliche	10	120
Sand	20	140
Clay, yellow	20	160
Pierre shale:		
Shale, blue	10	170
C8-48-36aa		
Ogallala formation:		
Sand and gravel	55	55
Caliche	35	90
Shale, gray	20	110
Pierre shale:		
Shale, blue	20	130
C8-48-36d		
Ogallala formation:		
Sand, gravel, and caliche	80	80
Gravel	10	90
Sand	20	110
Gravel	10	120
Sand	20	140
Clay, yellow	20	160
Pierre shale:		
Shale, blue	10	170
C8-49-21aa		
Ogallala formation:		
Clay	27	27
Sand and gravel	33	60
Clay, yellow	30	90
Pierre shale:		
Shale, blue	20	110
C8-50-1aa		
Ogallala formation:		
Clay	20	20
Gravel	28	48
Clay and caliche	52	100
Clay, yellow	40	140
Pierre shale:		
Shale, blue	10	150

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C8-50-6bb		
Ogallala formation:		
Gravel	10	10
Clay, yellow	60	70
Pierre shale:		
Shale, blue	20	90
C8-50-21aa		
Ogallala formation:		
Clay	40	40
Gravel	5	45
Shale, yellow	75	120
Pierre shale:		
Shale, blue	30	150
C8-51-6bb		
Ogallala formation:		
Clay	40	40
Clay, sandy	40	80
Sand and gravel	20	100
Sand	15	115
Clay, yellow	30	145
Pierre shale:		
Shale, blue	5	150
C8-51-22bb		
Ogallala formation:		
Clay	10	10
Gravel	50	60
Clay, yellow and gray	35	95
Pierre shale:		
Shale, blue	5	100
C9-42-14dd. Altitude, 3,993 feet		
Ogallala formation:		
Clay	20	20
Gravel	60	80
Clay and caliche	60	140
Sand and gravel	175	315
Pierre shale:		
Shale, blue	15	330
C9-42-16dd. Altitude, 4,004 feet		
Ogallala formation:		
Clay	20	20
Gravel	40	60

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-42-16dd--Continued		
Ogallala formation--Con.		
Clay and caliche; contains breaks of gravel	180	240
Sand	45	285
Pierre shale:		
Shale, blue	15	300
C9-42-19dd. Altitude, 4,064 feet		
Ogallala formation:		
Clay	30	30
Sand and gravel	270	300
Clay, yellow	10	310
Pierre shale:		
Shale, blue	10	320
C9-43-8dd. Altitude, 4,099 feet		
Ogallala formation:		
Clay and caliche; contains breaks of gravel	200	200
Sand	70	270
Pierre shale:		
Shale, blue	20	290
C9-43-16cd		
Ogallala formation:		
Clay	50	50
Sand and gravel	50	100
(No sample)	30	130
Gravel and breaks of caliche	70	200
(No sample)	80	280
Pierre shale:		
Shale, blue	10	290
C9-43-16dc		
Ogallala formation:		
Clay	40	40
Clay and caliche; contains breaks of gravel	230	270
Gravel	20	290
Pierre shale:		
Shale, blue	...	290

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-43-17ad. Altitude, 4,086 feet		
Soil, sandy	25	25
Ogallala formation:		
Sand and gravel	185	210
Sand, fine	50	260
Shale, gray	10	270
Pierre shale:		
Shale, blue	20	290
C9-43-17da. Altitude, 4,082 feet		
Ogallala formation:		
Gravel	20	20
Clay and caliche	40	60
Gravel	30	90
Clay and caliche; contains breaks of gravel	130	220
Sand	30	250
Clay, gray	10	260
Pierre shale:		
Shale, blue	20	280
C9-43-17dd. Altitude, 4,087 feet		
Soil, sandy	25	25
Ogallala formation:		
Sand and gravel	175	200
Sand, fine	70	270
Pierre shale:		
Shale, blue	20	290
C9-43-20ad. Altitude, 4,097 feet		
Soil and clay	25	25
Ogallala formation:		
Sand and gravel	185	210
Sand, fine	50	260
Shale, gray	10	270
Pierre shale:		
Shale, blue	20	290
C9-43-20da. Altitude, 4,134 feet		
Ogallala formation:		
Clay and caliche	70	70
Gravel	50	120
Clay and caliche; contains breaks of gravel	170	290

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-43-20da--Continued		
Pierre shale(?):		
Shale	20	310
C9-43-29aa. Altitude, 4,141 feet		
Ogallala formation:		
Clay, sandy	55	55
Sand and gravel	255	310
Pierre shale:		
Shale, blue	10	320
C9-43-29ad. Altitude, 4,165 feet		
Ogallala formation:		
Clay, sandy	60	60
Gravel	10	70
Clay, sandy	130	200
Sand and gravel	140	340
Pierre shale:		
Shale, blue	10	350
C9-43-29da. Altitude 4,168 feet		
Ogallala formation:		
Clay, sandy	50	50
Sand and gravel	50	100
Sand and gravel; contains caliche breaks	100	200
Gravel	140	340
Pierre shale:		
Shale, blue	10	350
C9-43-32aa. Altitude, 4,153 feet		
Ogallala formation:		
Clay, sandy	50	50
Sand and gravel	150	200
(No sample)	135	335
Pierre shale:		
Shale, blue	15	350
C9-43-32ad. Altitude, 4,148 feet		
Ogallala formation:		
Clay	50	50
Sand and gravel; contains small breaks of caliche and clay	230	280
Sand	30	310
Pierre shale:		
Shale, blue	50	360

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-43-32da. Altitude, 4,158 feet		
Ogallala formation:		
Clay and caliche	55	55
Gravel and sand	65	120
Caliche and gravel	35	155
Sand	145	300
Pierre shale:		
Shale, blue	10	310
C9-43-32dd. Altitude, 4,148 feet		
Ogallala formation:		
Clay and caliche	55	55
Gravel and sand	145	200
Sand and gravel streaks	70	270
Shale, sandy	25	295
Pierre shale:		
Shale, blue	15	310
C9-44-1a		
Ogallala formation:		
Clay	74	74
Gravel, with small breaks of clay	226	300
Pierre shale:		
Shale, blue	10	310
C9-44-24aa		
Ogallala formation:		
Clay	50	50
Gravel	30	80
Clay and caliche	145	225
Gravel	95	320
Clay, gray	10	330
Pierre shale:		
Shale, blue	10	340
C9-44-33dd. Altitude, 4,221 feet		
Ogallala formation:		
Clay	25	25
Gravel	40	65
Sand	45	110
Caliche	10	120
Sand and gravel	70	190
Shale, sandy	10	200

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-44-33dd--Continued		
Ogallala formation--Con.		
Sand and caliche	95	295
Shale, yellow	5	300
Pierre shale:		
Shale, blue	10	310
C9-44-36dd		
Ogallala formation:		
Sand and gravel, contains small breaks of clay	315	315
Clay, gray	5	320
Pierre shale:		
Shale, blue	...	320
C9-45-5aa. Altitude, 4,194 feet		
Ogallala formation:		
Clay, caliche, gravel, and breaks of sand	142	142
Clay, yellow	11	153
Pierre shale:		
Shale, blue	7	160
C9-45-13dd. Altitude, 4,270 feet		
Ogallala formation:		
Clay	20	20
Gravel	40	60
Clay and caliche	55	115
(No sample)	210	325
Pierre shale:		
Shale, blue	5	330
C9-45-16dd. Altitude, 4,309 feet		
Soil	20	20
Ogallala formation:		
Gravel	20	40
Clay and caliche; contains breaks of gravel	240	280
Sand	15	295
Pierre shale:		
Shale, blue	15	310

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-45-18cc. Altitude, 4,282 feet		
Ogallala formation:		
Clay..................	5	5
Gravel.................	23	28
Clay and caliche.......	72	100
Sand and gravel........	90	190
Clay..................	25	215
Pierre shale:		
Shale, blue...........	5	220
C9-45-23a. Altitude, 4,278 feet		
Ogallala formation:		
Clay..................	40	40
Gravel.................	35	75
Caliche...............	25	100
Sand and gravel streaks..............	70	170
Clay..................	20	190
Sand..................	80	270
Sand and gravel streaks..............	30	300
Clay, yellow..........	10	310
Pierre shale:		
Shale, blue...........	10	320
C9-45-33dd. Altitude, 4,303 feet		
Ogallala formation:		
Sand, gravel, and caliche..............	60	60
Shale, sandy..........	40	100
Caliche...............	20	120
Sand..................	40	160
Shale, sandy..........	40	200
Sand..................	55	255
Clay, yellow..........	15	270
Pierre shale:		
Shale, blue...........	10	280
C9-46-31cb. Altitude, 4,394 feet		
Ogallala formation:		
Gravel................	20	20
Caliche...............	70	90
Sand..................	10	100
Sand and gravel.......	30	130
Shale, gray..........	13	143
Pierre shale:		
Shale, blue...........	7	150

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-46-34cc. Altitude, 4,352 feet		
Ogallala formation:		
Clay..................	15	15
Gravel................	29	44
Clay and caliche; contains breaks of gravel....................	126	170
Clay, yellow..........	12	182
Pierre shale:		
Shale, blue...........	8	190
C9-46-36d. Altitude, 4,364 feet		
Ogallala formation:		
Sand and gravel........	50	50
Shale, sandy..........	70	120
Sand..................	100	220
Clay, yellow..........	20	240
Pierre shale:		
Shale, blue...........	...	240
C9-47-1ba. Drilled by K. G. Wilcox, 1949		
Soil....................	18	18
Ogallala formation:		
Rock, soft............	11	29
Rock, soft, and gravel.	8	37
Rock, soft............	3	40
Rock and sand.........	5	45
Caliche...............	5	50
Caliche, sandy........	4	54
Sand and gravel; contains strips of rock..	1	55
Rock, hard............	2	57
Gravel................	8	65
Gravel, coarse........	3	68
Sandstone.............	1	69
Clay, sandy...........	1	70
Sandstone.............	3	73
Gravel................	4	77
Caliche, hard.........	5	82
Clay and caliche......	23	105
Sandstone.............	4	109
(?)...................	1	110
Caliche, soft.........	10	120
Rock..................	17	137
Gravel................	18	155
Clay, sandy...........	3	158
Sand..................	2	160
Conglomerate..........	3	163

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-47-1ba--Continued		
Ogallala formation--Con.		
Sand and clay..........	4	167
Gravel.................	2	169
Clay...................	4	173
Conglomerate...........	1	174
Gravel.................	1	175
Conglomerate...........	15	190
Clay, white, containing strips of gravel......	4	194
Sand and gravel........	13	207
Gravel, coarse.........	2	209
Conglomerate...........	12	221
Gravel.................	13	234
Clay...................	5	239
Gravel.................	5	244
Pierre shale:		
Shale..................	1	245
C9-47-3b		
Ogallala formation:		
Clay and gravel........	109	109
Clay, yellow...........	11	120
Pierre shale:		
Shale, blue............	10	130
C9-47-5bb		
Ogallala formation:		
Clay and caliche.......	40	40
Gravel.................	110	150
Clay, yellow...........	10	160
Pierre shale:		
Shale, blue............	10	170
C9-47-6dd		
Ogallala formation:		
Sand and gravel........	60	60
Caliche................	40	100
Gravel.................	55	155
Pierre shale:		
Shale, blue............	5	160
C9-47-7dd		
Ogallala formation:		
Sand and gravel........	50	50
Caliche................	35	85
Gravel.................	50	135

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-47-7dd--Continued		
Pierre shale:		
Shale, blue............	5	140
C9-47-9bb		
Ogallala formation:		
Clay...................	50	50
Clay and gravel........	70	120
Clay, yellow...........	17	137
Pierre shale:		
Shale, blue............	3	140
C9-47-9c		
Ogallala formation:		
Sand...................	65	65
Gravel.................	5	70
Sand...................	20	90
Gravel.................	55	145
Shale, gray............	7	152
Pierre shale:		
Shale, blue............	8	160
C9-47-17dd		
Ogallala formation:		
Sand...................	70	70
Gravel.................	5	75
Sand and caliche.......	25	100
Shale, sandy...........	10	110
Clay, yellow...........	40	150
Pierre shale:		
Shale, blue............	10	160
C9-47-18cc		
Ogallala formation:		
Clay...................	70	70
Gravel.................	25	95
Clay...................	55	150
Sand...................	12	162
(No sample)............	8	170
Clay, yellow...........	10	180
Pierre shale:		
Shale, blue............	10	190
C9-47-18d		
Ogallala formation:		
Sand...................	60	60

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-47-18d--Continued		
Ogallala formation--Con.		
Caliche	25	85
Gravel	60	145
Shale, gray	5	150
Pierre shale:		
Shale, blue	10	160
C9-47-19cc		
Ogallala formation:		
Clay	60	60
Gravel	20	80
Clay	30	110
Clay, yellow	5	115
Pierre shale:		
Shale, blue	5	120
C9-47-24aa. Altitude, 4,441 feet		
Ogallala formation:		
Clay	30	30
Gravel	30	60
Clay and caliche	175	235
Clay, yellow	10	245
Pierre shale:		
Shale, blue	5	250
C9-47-30a		
Ogallala formation:		
Sand	10	10
Gravel	40	50
Clay, sandy	10	60
Gravel	20	80
Clay, sandy	10	90
Gravel	10	100
Shale, gray	10	110
Pierre shale:		
Shale, blue	10	120
C9-47-31a		
Ogallala formation:		
Sand	10	10
Gravel	10	20
Caliche	30	50
Sand	40	90
Clay, gray	5	95

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-47-31a--Continued		
Ogallala formation--Con.		
Shale, gray	10	105
Pierre shale:		
Shale, blue	5	110
C9-47-31bb		
Ogallala formation:		
Clay	120	120
Gravel	10	130
Clay, yellow	20	150
Pierre shale:		
Shale, blue	8	158
C9-48-3b		
Ogallala formation:		
Clay	40	40
Gravel	50	90
Clay	28	118
Clay, yellow	16	134
Pierre shale:		
Shale, blue	6	140
C9-48-4cc		
Ogallala formation:		
Sand	70	70
Caliche	20	90
Gravel	28	118
Pierre shale:		
Shale	12	130
C9-48-5a		
Ogallala formation:		
Sand and gravel	150	150
Pierre shale:		
Shale, blue	10	160
C9-48-8cc		
Ogallala formation:		
Clay and caliche	40	40
Gravel	89	129
Clay, yellow	21	150
Pierre shale:		
Shale, blue	10	160

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-48-17aa		
Ogallala formation:		
Sand	60	60
Caliche	20	80
Gravel	20	100
Pierre shale:		
Shale	10	110
C9-48-17dd		
Ogallala formation:		
Sand	10	10
Caliche	50	60
Gravel	50	110
Clay, sandy	17	127
Shale, gray	6	133
Pierre shale:		
Shale, blue	7	140
C9-48-20b		
Ogallala formation:		
Clay	20	20
Gravel	40	60
Clay, yellow	48	108
Pierre shale:		
Shale, blue	12	120
C9-48-31bb		
Ogallala formation:		
Sand and gravel	150	150
Clay, sandy	20	170
Shale, gray	5	175
Pierre shale:		
Shale, blue	5	180
C9-48-31d		
Ogallala formation:		
Clay	15	15
Sand and gravel, with small breaks of clay	150	165
Clay, yellow	10	175
Pierre shale:		
Shale, blue	5	180
C9-48-32bb		
Ogallala formation:		
Clay and caliche	65	65

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-48-32bb--Continued		
Ogallala formation--Con.		
Gravel	45	110
Clay, gray	35	145
Clay, yellow	17	162
Pierre shale:		
Shale, blue	8	170
C9-48-34c		
Ogallala formation:		
Sand and gravel	125	125
Clay, yellow	9	134
Pierre shale:		
Shale, blue	6	140
C9-49-1a		
Ogallala formation:		
Clay	50	50
Sand and gravel	70	120
Clay, yellow	32	152
Pierre shale:		
Shale, blue	8	160
C9-49-1dd		
Ogallala formation:		
Sand	90	90
Gravel	10	100
Sand	30	130
Clay, yellow	12	142
Pierre shale:		
Shale, blue	8	150
C9-49-13aa		
Ogallala formation:		
Sand and gravel	50	50
Shale, sandy, and caliche	20	70
Sand	40	110
Gravel	10	120
Sand and caliche	15	135
Clay, yellow	12	147
Pierre shale:		
Shale, blue	3	150

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-49-21aa		
Ogallala formation:		
Clay	20	20
Gravel	25	45
Sand and sandy clay	65	110
Caliche	20	130
Sand	25	155
Clay, yellow	20	175
Pierre shale:		
Shale, blue	5	180
C9-49-24aa		
Ogallala formation:		
Shale, sandy	50	50
Gravel	15	65
Sand	25	90
Shale, sandy	20	110
Sand	15	125
Clay, yellow	10	135
Pierre shale:		
Shale, blue	5	140
C9-49-24dd		
Ogallala formation:		
Sand	60	60
Gravel	10	70
Shale, sandy	40	110
Clay, yellow	10	120
Pierre shale:		
Shale, blue	10	130
C9-50-1aa		
Ogallala formation:		
Clay	15	15
Gravel	23	38
Clay and caliche	19	57
Clay, yellow	28	85
Pierre shale:		
Shale, blue	15	100
C9-50-28aa		
Ogallala formation:		
Clay	30	30
Gravel	30	60
Clay and caliche, with breaks of gravel	88	148

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-50-28aa--Continued		
Ogallala formation--Con.		
Clay, yellow	16	164
Pierre shale:		
Shale, blue	6	170
C9-51-1aa		
Ogallala formation:		
Clay	40	40
Caliche	15	55
Sand and gravel	35	90
Clay, yellow	40	130
Pierre shale:		
Shale, blue	20	150
C9-51-2baa. Drilled by Ben Hasz, 1948		
Ogallala formation:		
(No samples)	62	62
Sandstone and caliche; contains strips of sand	26	88
Sand, compact; contains strips of caliche	12	100
Rock	1	101
Clay	1	102
Sand, compact	1	103
Gravel, coarse, loose	10	113
Clay	9	122
C9-51-2bab. Drilled by Ben Hasz, 1948		
Ogallala formation:		
(No samples)	65	65
Caliche, clay, and some sand	25	90
Sand, containing strips of caliche	11	101
Gravel, good	9	110
Clay	12	122
C9-51-2bb. Drilled by Ben Hasz, 1948		
Ogallala formation:		
(No samples)	62	62
Sandstone and caliche	13	75
Sand, caliche, and some clay	5	80
Clay, caliche, and some sand	10	90

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-51-2bb--Continued		
Ogallala formation--Con.		
Gravel, loose..........	21	111
Clay..................	14	125
Pierre shale(?):		
Shale..................	2	127
C9-51-2bbb. Drilled by Ben Hasz, 1948		
Soil....................	21	21
Ogallala formation:		
Clay, sandy...........	6	27
Sand..................	18	45
Sand, containing strips of caliche and clay...	29	74
Sand, caliche, and sandy rock...........	17	91
Rock, sandstone, and some clay............	12	103
Gravel, loose..........	9	112
Clay..................	10	122
C9-51-2bbc. Drilled by Ben Hasz, 1948		
Soil....................	25	25
Ogallala formation:		
Sand..................	23	48
Caliche and sandy clay.	6	54
Sand, loose, containing some caliche..........	13	67
Caliche, compact, containing some sand.....	15	82
Sand, containing strips of caliche...........	11	93
Sandstone and compact sand.................	8	101
Gravel, loose..........	12	113
Rock..................	6	119
Clay..................	11	130
Pierre shale(?):		
Shale..................	...	130
C9-51-2bcb. Drilled by Ben Hasz, 1948		
Soil....................	25	25
Ogallala formation:		
Sand..................	31	56
Sand, caliche, and sandy clay...........	12	68

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C9-51-2bcb--Continued		
Ogallala formation--Con.		
Sand and caliche.......	20	88
Caliche and sandstone..	13	101
Gravel, loose..........	10	111
Clay..................	11	122
C9-51-6bb		
Ogallala formation:		
Clay and caliche.......	80	80
Gravel................	20	100
Caliche...............	15	115
Clay, gray............	10	125
Pierre shale:		
Shale, blue...........	5	130
C9-51-21aa		
Soil....................	5	5
Ogallala formation:		
Gravel................	7	12
Pierre shale:		
Shale, blue...........	108	120
C9-51-31cc		
Soil....................	3	3
Ogallala formation:		
Gravel................	6	9
Clay, gray and yellow..	61	70
Pierre shale:		
Shale, blue...........	10	80
C10-42-31dd1		
Ogallala formation:		
Shale, sandy..........	15	15
Gravel and caliche.....	25	40
Sand..................	15	55
Shale, sandy..........	25	80
Caliche...............	10	90
Sand..................	75	165
Clay, yellow..........	20	185
Shale, gray...........	5	190
Pierre shale:		
Shale, blue...........	10	200

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C10-42-31dd2		
Ogallala formation:		
Clay and caliche.......	180	180
Clay, yellow...........	10	190
Pierre shale:		
Shale, blue............	10	200
C10-42-35cc. Altitude, 4,002 feet		
Ogallala formation:		
Clay...................	5	5
Sand and gravel........	55	60
Clay and caliche.......	60	120
Clay, sandy............	30	150
Clay, yellow...........	10	160
Pierre shale:		
Shale, blue............	10	170
C10-43-25bb. Drilled by K. G. Wilcox, 1948		
Soil...................	3	3
Ogallala formation:		
Clay, yellow...........	32	35
Caliche................	5	40
Gravel.................	16	56
Caliche................	19	75
Gravel.................	7	82
Conglomerate...........	3	85
Clay, sandy, and gravel...................	6	91
Gravel.................	6	97
Sandstone..............	5	102
Sand and gravel........	8	110
Caliche................	4	114
Gravel.................	3	117
Conglomerate...........	8	125
Sandstone..............	4	129
Gravel.................	9	138
Clay...................	2	140
Conglomerate...........	5	145
Gravel.................	1	146
Clay, white............	2	148
Conglomerate...........	6	154
Gravel.................	2	156
Rock, hard.............	4	160
Gravel.................	3	163
Caliche................	5	168
Gravel.................	25	193
Clay...................	7	200

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C10-43-27cc. Drilled by K. G. Wilcox, 1948		
Soil...................	4	4
Ogallala formation:		
Clay, yellow...........	38	42
Clay, sandy............	6	48
Conglomerate...........	1	49
Caliche................	2	51
Clay, sandy............	3	54
Caliche, hard..........	20	74
Gravel.................	4	78
Conglomerate...........	6	84
Gravel.................	5	89
Caliche................	23	112
Clay...................	3	115
Gravel.................	14	129
Caliche, hard..........	3	132
Conglomerate...........	5	137
Caliche................	5	142
Gravel.................	4	146
Clay...................	2	148
Caliche................	7	155
Clay...................	3	158
Caliche................	1	159
Clay...................	1	160
Caliche................	5	165
Gravel.................	5	170
Caliche................	2	172
Gravel.................	8	180
Clay...................	2	182
Gravel.................	22	204
Clay, yellow...........	16	220
Gravel.................	5	225
Clay...................	4	229
Gravel.................	12	241
Clay, yellow...........	5	246
Gravel.................	15	261
Pierre shale:		
Shale, blue............	1	262
C10-43-35bb. Drilled by K. G. Wilcox, 1948		
Soil...................	5	5
Ogallala formation:		
Clay, yellow...........	42	47
Gravel.................	21	68
Caliche................	3	71
Clay, sandy............	9	80
Caliche................	22	102
Clay...................	3	105

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C10-43-35bb--Continued		
Ogallala formation--Con.		
Caliche	6	111
Clay	4	115
Conglomerate	2	117
Clay, sandy	2	119
Conglomerate	1	120
Clay, sandy	2	122
Sandstone	1	123
Gravel	5	128
Caliche	6	134
Clay, sandy	3	137
Gravel, loose	28	165
Clay	1	166
Gravel	12	178
Clay	2	180
Clay, sandy	34	214
Sand, fine, loose	16	230
Gravel	3	233
Caliche	1	234
Sand, coarse	12	246
Pierre shale:		
Shale, blue	1	247
C10-44-13dd		
Ogallala formation:		
Clay and caliche	110	110
(No sample)	160	270
Clay, gray	20	290
Pierre shale:		
Shale, blue	...	290
C10-44-16dd. Altitude, 4,248 feet		
Ogallala formation:		
Clay	30	30
Gravel	50	80
Clay and caliche	110	190
Gravel	80	270
Clay, gray	10	280
Pierre shale:		
Shale, blue	10	290
C10-44-31c. Altitude, 4,306 feet		
Ogallala formation:		
Clay	15	15
Gravel, caliche, and sand	50	65
Shale, sandy	35	100

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C10-44-31c--Continued		
Ogallala formation--Con.		
Caliche	20	120
Sand	25	145
Clay	5	150
(No sample)	20	170
Caliche	13	183
Sand	62	245
Clay, yellow	15	260
Shale, gray	10	270
Pierre shale:		
Shale, blue	10	280
C10-44-36d		
Ogallala formation:		
Clay and caliche	88	88
(No sample)	42	130
Sand	120	250
Clay, yellow	10	260
Pierre shale:		
Shale, blue	...	260
C10-45-2aa. Altitude, 4,243 feet		
Ogallala formation:		
Clay	28	28
Gravel and boulders	92	120
Clay and caliche	80	200
Sand and gravel	35	235
Clay, yellow	10	245
Pierre shale:		
Shale, blue	5	250
C10-45-16dd. Altitude, 4,296 feet		
Ogallala formation:		
Clay	20	20
Gravel	40	60
Clay and caliche	110	170
Sand and gravel	70	240
Clay, yellow	10	250
Pierre shale:		
Shale, blue	10	260
C10-45-19b. Altitude, 4,397 feet		
Silt	15	15
Ogallala formation:		
Gravel	15	30

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C10-45-19b--Continued		
Ogallala formation--Con.		
Caliche	120	150
Rock	10	160
Sand	120	280
Pierre shale:		
Shale, blue	10	290
C10-45-33c. Altitude, 4,373 feet		
Ogallala formation:		
Clay	23	23
Gravel	27	50
Clay and caliche; contains breaks of gravel	105	155
(No sample)	95	250
Clay, yellow	30	280
Pierre shale:		
Shale, blue	10	290
C10-46-16dd. Altitude, 4,442 feet		
Silt and clay	55	55
Ogallala formation:		
Sand and caliche	45	100
Sand	80	180
Clay, red	10	190
Sand	55	245
Shale, gray	17	262
Pierre shale:		
Shale, blue	8	270
C10-46-19cc. Altitude, 4,485 feet		
Ogallala formation:		
Sand	30	30
Caliche	60	90
Gravel	20	110
Clay, gray	20	130
Sand	10	140
Clay, gray	10	150
Caliche	10	160
Sand	88	248
Clay, yellow	4	252
Pierre shale:		
Shale, blue	8	260

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C10-46-34c. Altitude, 4,479 feet		
Silt and sand	50	50
Ogallala formation:		
Sand, with small breaks of caliche	40	90
Gravel	5	95
Sand	165	260
Clay, gray	10	270
Pierre shale:		
Shale, blue	10	280
C10-47-18a		
Soil	8	8
Ogallala formation:		
Clay and conglomerate	180	188
Sand (water)	12	200
Pierre shale:		
Shale	...	200
C10-48-2bb		
Ogallala formation:		
Sand	20	20
Shale, sandy	50	70
Gravel and sand	50	120
Shale, sandy	10	130
Sand	15	145
Clay, yellow	7	152
Pierre shale:		
Shale, blue	8	160
C10-48-4cc		
Ogallala formation:		
Sand and gravel	170	170
Clay, yellow	7	177
Pierre shale:		
Shale, blue	3	180
C10-48-5aa		
Ogallala formation:		
Sand and gravel	90	90
Shale, gray	20	110
Gravel	20	130
Clay, yellow	15	145
Pierre shale:		
Shale, blue	5	150

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C10-48-9cc		
Ogallala formation:		
Sand and gravel........	50	50
Shale, sandy...........	35	85
Gravel and sand........	70	155
Clay, yellow...........	10	165
Pierre shale:		
Shale, blue............	5	170
C10-48-10d		
Ogallala formation:		
Sand and gravel........	120	120
Shale, gray............	5	125
Clay, yellow...........	5	130
Pierre shale:		
Shale, blue............	20	150
C10-48-11bb		
Ogallala formation:		
Sand and gravel........	145	145
Clay, yellow...........	5	150
Pierre shale:		
Shale, blue............	10	160
C10-48-17d		
Ogallala formation:		
Clay and caliche.......	50	50
Sand...................	35	85
Shale, gray............	5	90
Sand...................	65	155
Clay, yellow...........	5	160
Pierre shale:		
Shale, blue............	20	180
C10-48-20d		
Ogallala formation:		
Sand and sandy shale...	50	50
Gravel.................	15	65
Sand and gravel........	70	135
Clay, yellow...........	5	140
Pierre shale:		
Shale, blue............	10	150

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C10-48-23cc		
Ogallala formation:		
Sand, gravel, and streaks of caliche....	155	155
Clay, yellow...........	10	165
Pierre shale:		
Shale, blue............	5	170
C10-48-29bb		
Ogallala formation:		
Clay...................	50	50
Gravel.................	50	100
Sand, with breaks of clay..................	35	135
Clay, yellow...........	17	152
Pierre shale:		
Shale, blue............	8	160
C10-48-30cc		
Ogallala formation:		
Sand, containing streaks of gravel.....	150	150
Clay, yellow...........	5	155
Pierre shale:		
Shale, blue............	5	160
C10-48-32b		
Ogallala formation:		
Gravel.................	38	38
Clay, with breaks of sand..................	42	80
Gravel.................	25	105
Clay, yellow...........	20	125
Pierre shale:		
Shale, blue............	5	130
C10-48-34c		
Ogallala formation:		
Clay...................	47	47
Gravel.................	63	110
Clay, with breaks of sand..................	75	185
Clay, yellow...........	10	195

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C10-48-34c--Continued		
Pierre shale:		
Shale, blue............	5	200
C10-49-13aa		
Ogallala formation:		
Shale, sandy...........	30	30
Sand...................	70	100
Sand and gravel........	50	150
Clay, yellow...........	10	160
Pierre shale:		
Shale, blue............	10	170
C10-49-24aa		
Ogallala formation:		
Shale, sandy, and caliche...................	50	50
Gravel.................	15	65
Sand, with streaks of gravel................	45	110
Shale, gray............	10	120
Sand...................	65	185
Clay, yellow...........	9	194
Pierre shale:		
Shale, blue............	6	200
C10-49-34da		
Soil...................	6	6
Ogallala formation:		
Clay and conglomerate..	116	122
Sand (water)...........	8	130
Pierre shale:		
Shale..................	...	130
C10-50-6b		
Ogallala formation:		
Clay...................	30	30
Gravel.................	20	50
Sand...................	10	60
Clay, yellow...........	20	80
Sandstone..............	10	90
Clay, gray.............	10	100
(No sample)............	10	110
Pierre shale:		
Shale, blue............	10	120

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C10-50-19aa		
Soil...................	8	8
Ogallala formation:		
Gravel and clay........	81	89
Sand (water)...........	11	100
Pierre shale:		
Shale..................	...	100
C10-50-22bb		
Ogallala formation:		
Clay...................	50	50
Gravel.................	15	65
Clay...................	25	90
Sand and gravel........	15	105
Clay, yellow and gray..	28	133
Pierre shale:		
Shale, blue............	7	140
C10-51-10ab. Drilled by K. G. Wilcox, 1949		
Soil...................	6	6
Ogallala formation:		
Sand and gravel........	8	14
Caliche, soft, and strips of clay........	14	28
Sand and gravel........	2	30
Sandstone..............	1	31
Sand and gravel........	7	38
Conglomerate...........	1	39
Sand and gravel, loose.	18	57
Conglomerate...........	6	63
Sand and gravel........	2	65
Conglomerate...........	2	67
Sand and gravel, loose.	2	69
Pierre shale(?):		
Shale, yellow..........	2	71
C10-51-22bb1		
Ogallala formation:		
Clay...................	20	20
Gravel.................	20	40
Clay, yellow...........	38	78
Pierre shale:		
Shale, blue............	12	90

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C11-41-19bc. Altitude, 4,026 feet		
Ogallala formation:		
Shale, sandy..........	10	10
(No sample)...........	26	36
Sand and gravel streaks..............	64	100
Sand..................	70	170
Shale, gray...........	10	180
Pierre shale:		
Shale, blue...........	120	300
C11-41-19cb. Altitude, 4,036 feet		
Soil....................	5	5
Ogallala formation:		
Caliche...............	28	33
Shale, sandy, with small sandstone breaks...............	57	90
Gravel................	15	105
Gravel, containing strips of clay........	75	180
Pierre shale:		
Shale, blue...........	120	300
C11-41-30bb. Altitude, 4,035 feet		
Ogallala formation:		
Sand and gravel........	174	174
Shale, gray...........	8	182
Pierre shale:		
Shale, blue...........	18	200
C11-42-1aa. Altitude, 3,998 feet		
Ogallala formation:		
Clay and caliche.......	40	40
Gravel................	40	80
Sand..................	30	110
Shale, sandy, and caliche..................	20	130
Sand..................	20	150
Clay, yellow..........	20	170
Pierre shale:		
Shale, blue...........	10	180
C11-42-3aa. Altitude, 4,011 feet		
Ogallala formation:		
Clay..................	10	10
Gravel................	50	60

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C11-42-3aa--Continued		
Ogallala formation--Con.		
Clay and caliche.......	70	130
Gravel................	14	144
Clay, yellow..........	10	154
Pierre shale:		
Shale, blue...........	6	160
C11-42-4aa		
Ogallala formation:		
Shale, sandy..........	15	15
Gravel and caliche.....	25	40
Sand..................	15	55
Shale, sandy..........	25	80
Caliche...............	10	90
Sand..................	75	165
Clay, yellow..........	20	185
Shale, gray...........	5	190
Pierre shale:		
Shale, blue...........	10	200
C11-42-13aa1		
Soil, sandy.............	30	30
Ogallala formation:		
Gravel................	18	48
Clay and caliche; contains small breaks of gravel............	72	120
Sand and gravel (water)..............	40	160
Clay, gray............	18	178
Pierre shale:		
Shale, blue...........	12	190
C11-42-13aa2		
Soil, sandy.............	20	20
Ogallala formation:		
Gravel................	20	40
Clay and caliche; contains gravel breaks...	80	120
Sand and gravel (water)..............	45	165
Clay, gray............	15	180
Pierre shale:		
Shale, blue...........	20	200

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C11-42-13ad. Altitude, 4,015 feet		
Ogallala formation:		
Sand and gravel........	160	160
Shale, gray...........	35	195
Pierre shale:		
Shale, blue...........	15	210
C11-42-13da. Altitude, 4,017 feet		
Soil, sandy.............	20	20
Ogallala formation:		
Clay; contains caliche breaks................	60	80
Gravel.................	80	160
Gravel; contains small breaks of clay........	20	180
Pierre shale:		
Shale, blue...........	20	200
C11-42-23aa. Altitude, 4,030 feet		
Ogallala formation:		
Sand and gravel........	180	180
Shale, gray...........	10	190
Pierre shale:		
Shale, blue...........	20	210
C11-42-23ad. Altitude, 4,028 feet		
Ogallala formation:		
Sand and gravel........	100	100
Sand..................	70	170
Shale, gray...........	5	175
Pierre shale:		
Shale, blue...........	25	200
C11-42-23dd		
Ogallala formation:		
Clay..................	25	25
Caliche...............	28	53
Gravel, with breaks of shale................	67	120
Gravel................	70	190
Shale, gray...........	10	200
Pierre shale:		
Shale, blue...........	30	230

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C11-42-24ab. Altitude, 4,018 feet		
Ogallala formation:		
Sand..................	100	100
Sand and gravel........	70	170
Shale, gray...........	10	180
Pierre shale:		
Shale, blue...........	20	200
C11-42-24ba. Altitude, 4,034 feet		
Ogallala formation:		
Clay and small breaks of caliche...........	80	80
Gravel.................	90	170
Clay, yellow..........	23	193
Pierre shale:		
Shale, blue...........	27	220
C11-42-25aa		
Soil....................	4	4
Ogallala formation:		
Caliche...............	21	25
Shale, contains breaks of gravel and sandstone...............	95	120
Gravel................	40	160
(No sample)...........	30	190
Pierre shale:		
Shale, blue...........	30	220
C11-43-11ca. Drilled by K. G. Wilcox, 1948		
Soil....................	13	13
Ogallala formation:		
Gravel................	7	20
Sandstone.............	8	28
Clay..................	3	31
Caliche...............	8	39
Gravel................	5	44
Caliche...............	17	61
Clay, sandy...........	1	62
Caliche...............	2	64
Clay, sandy, and gravel..................	2	66
Sandstone.............	3	69
Gravel................	3	72

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C11-43-11ca--Continued		
Ogallala formation--Con.		
Caliche, hard	3	75
Gravel	2	77
Caliche, containing joint clay	4	81
Caliche and clay	5	86
Gravel	2	88
Conglomerate	7	95
Gravel	3	98
Caliche	2	100
Gravel	6	106
Rock	2	108
Clay, sandy, and gravel	7	115
Clay	16	131
(?)	8	139
Clay, sandy	9	148
Sand, fine	2	150
Joint clay	.5	150.5
Clay	10.5	161
Joint clay	5	166
Gravel	12	178
Gravel and clay	6	184
Rock	.....	184
C11-43-12cc. Drilled by K. G. Wilcox, 1948		
Soil	15	15
Ogallala formation:		
Gravel, coarse	32	47
Caliche, soft	4	51
Gravel, fine	11	62
Caliche, soft	3	65
Gravel, fine	7	72
Caliche, soft	3	75
Clay, soft, white	5	80
Gravel	4	84
Conglomerate, broken	11	95
Clay, sandy	10	105
Caliche, soft	2	107
Caliche, hard, and clay	1	108
Rock, hard	1	109
Clay, soft, red	6	115
Caliche, soft, and clay	3	118
Gravel	5	123

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C11-43-12cc--Continued		
Ogallala formation--Con.		
Conglomerate, hard	5	128
Gravel, fine	.5	128.5
Clay, yellow	3.5	132
Caliche, hard	1.5	133.5
Caliche, soft, and clay	1	134.5
Gravel, fine	3.5	138
Caliche, hard	5	143
Gravel, fine	2	145
Clay, sandy, yellow	18	163
Gravel	8	171
Clay	4	175
Rock	3	178
Gravel	7	185
Clay	4	189
Gravel and clay	6	195
Gravel	10	205
Clay	3	208
Rock, hard	1.5	209.5
Gravel, coarse	10.5	220
Gravel and sand	15	235
Rock	.5	235.5
Gravel and strips of clay	1.5	237
Rock	.....	237
C11-44-2b. Altitude, 4,268 feet		
Ogallala formation:		
Clay	10	10
Gravel	30	40
Clay and caliche	210	250
Sand	40	290
Clay, yellow	10	300
Pierre shale:		
Shale, blue	10	310
C11-45-2b. Altitude, 4,374 feet		
Ogallala formation:		
Clay	10	10
Gravel	8	18
Shale, sandy	32	50
Gravel	7	57
Shale, sandy	73	130
Sand	85	215

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C11-45-2b--Continued		
Ogallala formation--Con.		
Shale, gray............	10	225
Shale, sandy...........	5	230
Shale, yellow..........	10	240
Pierre shale:		
Shale, blue............	10	250
C11-48-5b		
Ogallala formation:		
Gravel.................	20	20
Clay...................	20	40
Clay and breaks of sand..................	60	100
Clay, yellow...........	10	110
Pierre shale:		
Shale, blue............	10	120
C11-49-2		
Soil.....................	6	6
Ogallala formation:		
Clay and conglomerate..	64	70
Sand (water)...........	10	80
Pierre shale:		
Shale..................	...	80
C11-49-5bb		
Ogallala formation:		
Clay...................	20	20
Gravel.................	10	30
Clay and caliche.......	70	100
Clay, yellow...........	20	120
Pierre shale:		
Shale, blue............	10	130
C11-49-11bc		
Soil.....................	6	6
Ogallala formation:		
Clay and conglomerate..	142	148
Sand (water)...........	6	154
Pierre shale:		
Shale..................	...	154

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C11-49-22a		
Soil.....................	10	10
Ogallala formation:		
Conglomerate and clay..	129	139
Sand (water)...........	6	145
Pierre shale:		
Shale..................	...	145
C11-50-2ba		
Soil.....................	5	5
Ogallala formation:		
Clay and conglomerate..	131	136
Sand (water)...........	4	140
Pierre shale:		
Shale..................	...	140
C11-50-6bb		
Ogallala formation:		
Clay...................	45	45
Gravel.................	25	70
Clay...................	25	95
Sand...................	20	115
Clay, yellow...........	22	137
Pierre shale:		
Shale, blue............	13	150
C11-50-32cc		
Ogallala formation:		
Clay...................	8	8
Sand, with breaks of clay.................	22	30
(?)....................	90	120
Clay, yellow...........	27	147
Pierre shale:		
Shale, blue............	13	160
C11-51-5bb		
Ogallala formation:		
Clay...................	8	8
Gravel.................	7	15
Clay, yellow...........	53	68
Pierre shale:		
Shale, blue............	12	80

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Kit Carson County--Continued

	Thickness (feet)	Depth (feet)
C11-51-23bb		
Ogallala formation:		
Clay	15	15
Gravel	25	40
Clay	45	85
Sand	20	105
Clay, yellow	18	123
Pierre shale:		
Shale, blue	7	130

Lincoln County

	Thickness (feet)	Depth (feet)
C7-52-27ba. Drilled by Ben Hasz, 1949		
Ogallala formation:		
(No samples)	156	156
Sandstone	6	162
Sand, tight	22	184
Sandstone and clay	8	192
Clay	2	194
Sand and gravel, with some clay	22	216
Clay	5	221
C8-52-14cd1. Drilled by K. G. Wilcox, 1949		
Ogallala formation:		
(No samples)	70	70
Rock	11	81
Gravel	9	90
Rock, hard	1.5	91.5
Sandstone, soft	3.5	95
Clay, sandy	4	99
Sandstone	3	102
Clay, sandy	.5	102.5
Sand and gravel	1	103.5
Gravel, containing strips of rock	8.5	112
Caliche	2	114
Gravel	11.5	125.5
Conglomerate	.5	126
Pierre shale(?):		
Shale	5	131

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Lincoln County--Continued

	Thickness (feet)	Depth (feet)
C8-52-14cd2. Drilled by K. G. Wilcox, 1949		
Soil	1	1
Ogallala formation:		
Clay	21	22
Caliche, soft, and gravel	15	37
Clay	3	40
Caliche and clay	7	47
Gravel	11	58
Gravel, coarse, containing strips of rock	7	65
Rock, containing strips of clay and gravel	10	75
Rock, hard	4	79
Gravel, containing strips of clay and rock	9	88
Rock, hard	10	98
Rock, hard, containing strips of clay	5	103
Gravel, containing strips of rock	15	118
Gravel, coarse	10	128
C8-52-24aa. Drilled by Ben Hasz, 1948		
Ogallala formation:		
(No samples)	47	47
Sand, fair	8	55
Sand and clay	6	61
Clay	8	69
Clay, sandy, loose	16	85
Sand	7	92
Clay, sandy	8	100
Sand	16	116
Clay	4	120
C8-52-24cb. Drilled by Ben Hasz, 1948		
Ogallala formation:		
(No samples)	52	52
Sand and sandstone	4	56
Clay, sandy, tight	18	74
Sand, clayey, loose	9	83
Clay, sandy, tight	6	89

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Lincoln County--Continued

	Thickness (feet)	Depth (feet)
C8-52-24cb--Continued		
Ogallala formation--Con.		
Sand, loose, and clay..	11	100
Sand..................	14	114
Sand and sandstone.....	3	117
Clay..................	3	120
C8-52-24cc. Drilled by Ben Hasz, 1948		
Ogallala formation:		
(No samples)..........	44	44
Sand..................	14	58
Sandstone, caliche, and clay.................	6	64
Clay..................	12	76
Clay, sandy...........	6	82
Sandstone.............	7	89
Sand, tight...........	9	98
Sand..................	16	114
Sandstone.............	2	116
Clay..................	3	119
C8-53-1dd. Drilled by Jack Doty, 1946		
Soil and clay, sandy.....	20	20
Ogallala formation:		
Sand, fine to medium...	8	28
Sand, containing strips of clay..............	9	37
Sand and caliche.......	3	40
Sand, medium to coarse.	15	55
Sand and caliche.......	3	58
Sand, medium to coarse.	7	65
Sand and caliche.......	6	71
Sand, medium to coarse, containing caliche....	7	78
Caliche, hard..........	6	84
Sand, fine to medium...	8	92
Clay, yellow..........	8	100
C9-53-12aa. Drilled by Jack Doty, 1946		
Soil and clay, sandy.....	19	19
Ogallala formation:		
Sand, fine............	8	27
Caliche, soft.........	3	30
Sand, fine............	8	38
Clay..................	6	44
Sand, medium to coarse.	8	52

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Lincoln County--Continued

	Thickness (feet)	Depth (feet)
C9-53-12aa--Continued		
Ogallala formation--Con.		
Sand and caliche.......	5	57
Sand..................	5	62
Caliche, hard..........	2	64
Sand, medium to coarse, containing caliche and clay..................	8	72
Sand, fine............	3	75
Caliche, soft..........	7	82
Sand, medium to coarse.	10	92
Clay, yellow, containing gravel and boulders.................	18	110
C9-53-12bc. Drilled by Jack Doty, 1946		
Soil, sand, and clay.....	24	24
Ogallala formation:		
Sand..................	6	30
Caliche, soft..........	2	32
Sand, caliche, and clay.................	10	42
Sand, medium to coarse.	6	48
Caliche, soft, brown...	5	53
Sand, medium to coarse.	6	59
Sand, fine, containing caliche and clay......	21	80
Sandstone, brown and white................	5	85
Clay, yellow..........	15	100
C9-54-18ca. Drilled by K. G. Wilcox, 1950		
Ogallala formation:		
Sand, very fine to medium, clayey, tan...	3	3
Clay, firm, brown......	1.2	4.2
Sand, very fine to medium, clayey, tan...	3.3	7.5
Gravel, fine to coarse, containing fine to coarse sand; tan......	1	8.5
Sand, very fine to coarse, containing fine to coarse gravel with fragments of caliche and lenses of clay.................	9.5	18.0

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Lincoln County--Continued

	Thickness (feet)	Depth (feet)
C9-54-18ca--Continued		
Ogallala formation--Con.		
Clay, firm to soft, tan to yellowish-tan	5	23
Clay, firm, gray with yellow staining	5	28
Caliche, hard, gray and white	.5	28.5
Pierre shale:		
Clay, firm, gray with yellow to dark-gray stains	3.5	32

Logan County

	Thickness (feet)	Depth (feet)
B6-49-19d		
Soil	5	5
Ogallala formation:		
Sand and clay	55	60
Gravel	10	70
Pierre shale:		
Shale, blue	280	350
B6-50-27c		
Soil	2	2
Ogallala formation:		
Caliche	13	15
Gravel	20	35
Shale, yellow	45	80
Pierre shale:		
Shale, blue	140	220
B6-50-31a		
Soil	15	15
Ogallala formation:		
Sand and clay, yellow	120	135
Shale, yellow	50	185
Quicksand and clay	15	200
Pierre shale:		
Shale, hard	...	200

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Logan County--Continued

	Thickness (feet)	Depth (feet)
B6-51-3b		
Soil	1.5	1.5
Ogallala formation:		
Sand and clay	8.5	10
Clay	40	50
Gravel	25	75
Pierre shale:		
Shale	187	262
B6-51-3c1		
Soil	2	2
Ogallala formation:		
Loam, sandy	8	10
Clay	50	60
Gravel	20	80
Pierre shale:		
Shale	160	240
B6-51-3c2		
Soil	2	2
Ogallala formation:		
Loam, sandy	8	10
Clay	50	60
Gravel	25	85
Pierre shale:		
Shale	140	225
B6-51-4d		
Soil	1.5	1.5
Ogallala formation:		
Sand and clay	8.5	10
Clay	40	50
Gravel	30	80
Pierre shale:		
Shale	145	225
B7-49-7d		
Soil	5	5
Ogallala formation:		
Sand and clay	65	70
Sand	20	90
Gravel	10	100
Clay	50	150
Pierre shale:		
Shale	30	180

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Logan County--Continued

	Thickness (feet)	Depth (feet)
B7-49-28d		
Soil....................	6	6
Ogallala formation:		
Sand and clay..........	19	25
Clay..................	35	60
Pierre shale:		
Shale.................	90	150
B7-50-2d		
Soil....................	5	5
Ogallala formation:		
Sand and clay..........	20	25
Gravel................	10	35
Clay..................	90	125
Pierre shale:		
Shale.................	60	185

Phillips County

	Thickness (feet)	Depth (feet)
B7-43-18ab. Drilled by Arthur Haggert, 1949		
Soil....................	5	5
Ogallala formation:		
Sand, silty, and gravel..................	50	55
Sand, gravel, clay, and caliche..............	36	91
Sand and gravel........	49	140
Clay..................	2	142
Clay interbedded with sand and gravel.......	21	163
Sand..................	2	165
Sand and gravel........	18	183
Sand and gravel, hard..	9	192
Sand, silty, hard......	10	202
Sand, fair............	5	207
Sand and gravel........	28	235
B7-43-33ac. Drilled by L. L. Canfield, 1941		
Soil....................	5	5
Ogallala formation:		
Clay..................	12	17
Clay and sand..........	13	30
Clay..................	10	40

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Phillips County--Continued

	Thickness (feet)	Depth (feet)
B7-43-33ac--Continued		
Ogallala formation--Con.		
Sand and gravel........	10	50
Caliche and clay.......	10	60
Sandstone and clay.....	15	75
Gravel................	11	86
Sandstone.............	2	88
Gravel, fine..........	2	90
Sandstone.............	7	97
Sandstone and clay.....	10	107
Gravel................	3	110
Caliche, clay, and sandstone............	32	142
Gravel................	10	152
Sandstone.............	6	158
Gravel................	14	172
Sandstone.............	2	174
Gravel................	18	192
Sandstone, caliche, and clay.................	10	202
Gravel................	3	205
Caliche, clay, and soapstone............	9	214
Gravel................	26	240
B7-44-7dd. Dug by Kelly Well Co. Inc., 1921		
Ogallala formation:		
(No samples)..........	135	135
Clay and gravel........	6	141
Sand and gravel........	15	156
Clay..................	12	168
Gravel................	3	171
Clay..................	.5	171.5
Gravel................	51	222.5
B7-44-17bc. Dug by Kelly Well Co. Inc., 1949		
Soil....................	4	4
Ogallala formation:		
Sand, containing fragments of caliche......	68	72
Clay, sandy, containing fragments of caliche..	15	87
Clay, sandy, and gravel..................	10	97
Sand and gravel........	15	112
Shale and gravel.......	10	122

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Phillips County--Continued

	Thickness (feet)	Depth (feet)
B7-44-17bc--Continued		
Ogallala formation--Con.		
Clay, sandy, and gravel	15	137
Clay, sandy, and shale	10	147
Gravel, coarse, and clay	47	194
Clay, sandy, and gravel	18	212
Clay and gravel	51.5	263.5
B7-47-5		
Loam, black	1.5	1.5
Ogallala formation:		
Caliche	70.5	72
Sand	100	172
Rock, hard	6	178
Clay, red	12	190
Shale, yellow (water)	100	290
Pierre shale:		
Shale, blue	116	406
Mud, black	70	476
Clay, flaky	74	550
B8-47-21cc. Dug by Kelly Well Co. Inc., 1921		
Ogallala formation:		
Sand and gravel, coarse, slightly cemented	150	150
Sand and gravel, coarse	3	153
Clay, hard, and gravel	14	167
Sand, fine	4	171
Gravel, cemented	1	172
Sand, loose, and cobbles	3	175
Sand, fine	4	179
Gravel, medium	10	189
Gravel, cemented	2	191
Sand, coarse	11.5	202.5
Clay, hard, and rocks	3.5	206
Clay, hard	27	233

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Phillips County--Continued

	Thickness (feet)	Depth (feet)
B8-47-29aa. Drilled by L. L. Canfield, 1948		
Ogallala formation:		
Gravel, fine to medium, pink, gray, and black mottled; contains sand and silt	5	5
Silt loam, sandy, micaceous, buff-tan; contains roots and organic matter in upper section	13	18
Sand, coarse, pink and gray, containing gravel	7	25
Sand, fine to coarse, and silt, buff-brown; contains gravel and clay	2	27
Caliche, sandy, calcareous, porous, friable, buff	4	31
Clay, sandy, calcareous, weakly compacted, friable, buff; contains a small amount of fine to medium gravel and a few calcareous concretions as much as 1 inch in diameter	9	40
Caliche, sandy, slightly plastic, light-brown	12	52
Gravel, calcareous, tan-gray, containing medium to coarse sand and pebbles	20	72
Clay, sandy, firm, light-gray, containing medium to coarse sand	6	78
Caliche, firm, friable, buff-gray, containing minor amount of medium sand	7	85
Sand, slightly silty, argillaceous, friable to loose, gray; contains some gravel	3	88
Caliche, sandy, friable, light-gray	4	92

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Phillips County--Continued

	Thickness (feet)	Depth (feet)
B8-47-29aa--Continued		
Ogallala formation--Con.		
Sand, medium to coarse, loose, gray	10	102
Sand, medium to coarse, argillaceous, highly calcareous, porous, compact, friable, buff	23	125
Caliche, silty to slightly sandy, micaceous, plastic to firm, light-buff	17	142
Sand, fine to medium, slight clay binder, very friable, tan; contains water-worn pebbles of clay and small pipy calcareous concretions in the lower section	15	157
Caliche, plastic to firm, light-gray, containing fine sand	3	160
Gravel and sand; slight calcareous clay binder; fine to medium sand at top grading to medium and coarse gravel at base; loosely compacted; gray, tan, and brown	15	175
Clay, sandy, calcareous, firm to hard, brown to buff	10	185
Gravel, coarse, subrounded, buff	7	192
Clay, sandy, calcareous, firm to hard, tan	6	198
Gravel (reported)	17	215
Clay (reported)	2	217

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Sedgwick County

	Thickness (feet)	Depth (feet)
B10-44-35ca. Drilled by Ellithorpe and Putnam, 1949		
Soil	12	12
Ogallala formation:		
Gravel	21	33
Clay	15	48
Gravel	47.5	95.5
Cobbles	.5	96
Gravel, cemented	37	133
Gravel, loose	6	139
Sand, containing strips of caliche	14	153
Gravel, containing strips of caliche	30	183
Clay	15	198
Gravel, containing strips of caliche	2	200
Caliche	2	202
Gravel, coarse, loose	16	218
Clay	4	222
Gravel, coarse, fairly loose	21	243
Gravel, coarse, red, black, and white	22	265
Gravel, containing strips of caliche	8	273
Gravel, interbedded with caliche	15	288
Gravel, loose	15	303
Gravel, loose, containing some clay	28	331
Clay, hard	17	348
B10-44-35db. Drilled by Ellithorpe and Putnam, 1949		
Soil	12	12
Ogallala formation:		
Gravel	28	40
Clay	15	55
Gravel	34	89
Cobbles	3	92
Rock	1	93

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Sedgwick County--Continued

	Thickness (feet)	Depth (feet)
B10-44-35db--Continued		
Ogallala formation--Con.		
Clay	22	115
Clay, very hard	5	120
Caliche	13	133
Gravel, cemented	17	150
Clay, pink	17	167
Clay, hard, in strips	30	197
Clay, sandy, coarse, firm	30	227
Clay, sandy, coarse, medium firm	24	251
Clay	6	257
Gravel, coarse, and medium firm clay	15	272
Clay	15	287
Gravel, coarse, containing medium firm clay	36	323
Rock	7	330
Sand, coarse, grading to medium gravel	17	347
Gravel, coarse, containing medium firm clay	30	377
Sand, cemented	30	407

Washington County

	Thickness (feet)	Depth (feet)
B1-51-11b		
Soil	2	2
Ogallala formation:		
Gravel	7	9
Rock and gravel	251	260
Soapstone	6	266
Gravel	33	299
Pierre shale:		
Shale, blue	1	300
B2-52-2b		
Soil	25	25
Ogallala formation:		
Gravel, cemented, hard	25	50
Rock, hard	20	70

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Washington County--Continued

	Thickness (feet)	Depth (feet)
B2-52-2b--Continued		
Ogallala formation--Con.		
Sandstone	8	78
Sandstone, soft	4	82
Rock, hard	3	85
Sandstone and caliche	15	100
Sandstone and brown shale	58	158
Pierre shale:		
Shale	27	185
B2-52-8aadc1. Drilled by Chicago Burlington & Quincy Railroad Co., 1919		
Ogallala formation:		
Clay, blue	25	25
Rock, white	4.5	29.5
Caliche	61	90.5
Sandstone	14	104.5
B2-52-8aadc2. Drilled by Chicago Burlington & Quincy Railroad Co., 1919		
Cinders	1.5	1.5
Ogallala formation:		
Clay, blue	25	26.5
Caliche	57.5	84
Caliche, very hard	16.5	100.5
B2-52-8abdc. Drilled by Chicago Burlington & Quincy Railroad Co., 1919		
Cinders	1	1
Ogallala formation:		
Clay, blue	11	12
Caliche	13	25
Rock, white	4.5	29.5
Caliche	43	72.5
Rock, white	7.3	79.8
Sand (water)	6	85.8
B2-52-8adb. Drilled by Chicago Burlington & Quincy Railroad Co., 1917		
Ogallala formation:		
Clay	26	26
Clay, sandy	49	75
Clay	5	80
Sand, coarse	8	88
Pierre shale(?):		
Shale, gray	14	102

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Washington County--Continued

	Thickness (feet)	Depth (feet)
B2-52-8bbadc. Drilled by Chicago Burlington & Quincy Railroad Co., 1919		
Cinders	1	1
Ogallala formation:		
Clay, blue	24	25
Rock, white	4.5	29.5
Caliche	52	81.5
Sand	4	85.5
Sand, loose (water)	3	88.5
Rock, white	...	88.5
B2-52-8bbdc. Drilled by Chicago Burlington & Quincy Railroad Co., 1919		
Ogallala formation:		
Clay	38	38
Caliche, hard	2	40
Sand and gravel	20	60
Gravel, cemented	14	74
Clay and sand	6	80
Sand and sandstone	30	110
Limestone	20	130
Limestone, brown	8	138
Joint clay and yellow clay	27	165
Caliche, yellow	60	225
Pierre shale:		
Shale, gray	115	340
Sandstone	10	350
Shale, gray	110	460
Sandstone	15	475
Sandstone and shale	25	500
Shale, gray, and sand	340	840
Sandstone	4	844
Shale, gray	101	945
Sandstone, containing oil stain	2	947
Shale, gray	583	1,530
Shale, granulated	12	1,542
Shale, gray	141	1,683
B2-52-8bcbc. Drilled by Chicago Burlington & Quincy Railroad Co., 1919		
Ogallala formation:		
Clay, blue	13	13
Caliche	52	65
Gravel, pink, and soil	3	68

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Washington County--Continued

	Thickness (feet)	Depth (feet)
B2-52-8bcbc--Continued		
Ogallala formation--Con.		
Sand, white, and shale	33	101
Pierre shale(?):		
Shale, blue	3	104
Shale, white	23	127
B2-52-8cdac. Drilled by Chicago Burlington & Quincy Railroad Co., 1919		
Cinders	2	2
Ogallala formation:		
Clay, blue	23	25
Caliche	49	74
Sand	12	86
B2-52-8dbadc. Drilled by Chicago Burlington & Quincy Railroad Co., 1919		
Cinders	1	1
Ogallala formation:		
Clay, blue	19.5	20.5
Rock, white	4.5	25
Caliche	27	52
Shale, white	7	59
Clay and gravel	51	110
B2-52-8dbc. Drilled by Chicago Burlington & Quincy Railroad Co., 1919		
Cinders	3	3
Ogallala formation:		
Clay, blue	10	13
Caliche	68	81
Sand, fine (water)	6	87
Sand, medium (water)	5	92
Pierre shale(?):		
Shale	...	92
B2-52-8dcac. Drilled by Chicago Burlington & Quincy Railroad Co., 1919		
Cinders	1	1
Ogallala formation:		
Clay, blue	24	25
Rock, white	4.5	29.5
Caliche	52	81.5
Sand, medium (water)	11	92.5

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Washington County--Continued

	Thickness (feet)	Depth (feet)
B2-52-8dcbc. Drilled by Chicago Burlington & Quincy Railroad Co., 1919		
Ogallala formation:		
Clay, blue	24	24
Rock, white	4.5	28.5
Caliche	47.5	76
Shale, white	30	106
Caliche	14	120
B2-52-8ddac. Drilled by Chicago Burlington & Quincy Railroad Co., 1919		
Ogallala formation:		
Clay, blue	24.5	24.5
Rock, white	5.5	30
Caliche	51	81
Shale, white	7	88
Clay and gravel	39	127
B2-52-9b		
Ogallala formation:		
Clay	20	20
Caliche, hard	20	40
Limestone(?), hard	20	60
Rock, very hard	10	70
Sandstone, very hard	15	85
Sand and gravel	4	89
Limestone(?), very hard	2	91
Clay, white	9	100
Pierre shale:		
Soapstone and shale	152	252
C2-51-18b		
Ogallala formation:		
Sand	25	25
Gravel	45	70
Clay	25	95
Sand	75	170
Gravel	20	190
Shale, yellow	4	194
Pierre shale:		
Shale, blue	1	195
C4-51-7d		
Ogallala formation:		
Clay	40	40
Gravel	15	55

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Washington County--Continued

	Thickness (feet)	Depth (feet)
C4-51-7d--Continued		
Ogallala formation--Con.		
Clay and gravel	5	60
Soapstone	3	63
Gravel	7	70
Pierre shale:		
Shale	1	71
C5-49-4bb. Drilled by L. L. Canfield, 1950		
Soil	3	3
Ogallala formation:		
Clay	2	5
Sand and gravel	6	11
Clay	5	16
Clay, hard	4	20
Clay	5	25
Gravel, solid	12	37
Gravel	19	56
Rock	2	58
Gravel and clay	4	62
Sand, gravel, and clay	14	76
Pierre shale:		
Shale	4	80

Yuma County

	Thickness (feet)	Depth (feet)
B1-43-6bc. Dug by Kelly Well Co. Inc., 1921		
Soil and sand	12	12
Ogallala formation:		
Sand, fine	40	52
Shale	1	53
Sand, fine	21	74
Pierre shale(?):		
Shale	2	76
B1-43-7a		
Soil	1	1
Ogallala formation:		
Rock	9	10
Sand	10	20
Clay	11	31
Gravel	27	58
Clay and gravel	15	73

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Yuma County--Continued

	Thickness (feet)	Depth (feet)
B1-43-7a--Continued		
Ogallala formation--Con.		
Clay	10	83
Rock	10	93
Clay	4	97
Gravel	23	120
B1-43-28d		
Soil	3	3
Ogallala formation:		
Caliche	20	23
Clay	20	43
Gravel	25	68
Clay	18	86
Rock	15	101
Gravel	26	127
(No sample)	13	140
Pierre shale:		
Shale	145	285
B1-44-4a		
Soil	2	2
Ogallala formation:		
Rock	2	4
Sand	17	21
Gravel	14	35
Rock	5	40
Gravel	10	50
Rock	11	61
Shale	6	67
Gravel	23	90
B2-42-34cc. Drilled by L. L. Canfield, 1949		
Sand	11	11
Ogallala formation:		
Hardpan	7	18
Clay	16	34
Sand, fine	7	41
Clay	6	47
Gravel and sand	9	56
Gravel and clay	4	60
Gravel, hard, thinly bedded	5	65
Shale, yellow	4	69
Pierre shale:		
Shale, black	11	80

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Yuma County--Continued

	Thickness (feet)	Depth (feet)
B2-44-24cd		
Soil	3	3
Ogallala formation:		
Caliche	8	11
Clay	20	31
Gravel	20	51
Rock	23	74
Gravel	18	92
Rock	12	104
Gravel	26	130
B2-48-15dd. Drilled by William Schocke, 1950		
Ogallala formation:		
Soil and caliche, sandy	60	60
Gravel	10	70
Sand	10	80
Silt and gravel, red	40	120
Sand	30	150
Gravel	10	160
"Formation," white	20	180
Sand	10	190
Gravel (water)	10	200
Silt, red, and gravel	30	230
Gravel (water)	10	240
B2-48-22ac		
Ogallala formation:		
(No samples)	200	200
Sand and caliche (water)	3	203
Caliche, soft	.5	203.5
Caliche, clay, and gravel	(?)	(?)
Caliche, soft	(?)	(?)
Clay and gravel	(?)	(?)
Caliche, soft	(?)	213
Clay, very compact	9.5	222.5
Caliche	.5	223
Clay and sand	4	227
Sand, fine, and caliche	13	240
Clay and sand	10	250
Caliche and gravel	4	254
Caliche and sandstone	1	255
Clay, very compact	12	267
Clay, heavy, yellow	10	277

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Yuma County--Continued

	Thickness (feet)	Depth (feet)
B2-48-22ac--Continued		
Ogallala formation--Con.		
Clay, compact, and sand; contains chips of shale	19	296
Caliche, hard	1	297
Clay, sandy (water)	13	310
Gravel (water)	2	312
Caliche, hard	8	320
B2-48-22da1. Drilled by Chicago Burlington & Quincy Railroad Co., 1918		
Ogallala formation:		
Sand	45	45
Sand, coarse	10	55
Clay and sand	20	75
Sand	4	79
Clay and sand	30	109
Sand and gravel	30	139
Sand, fine	30	169
Sand	6	175
Sandstone	3	178
Gravel	30	208
Clay and sand	10	218
B2-48-22da2. Drilled by Chicago Burlington & Quincy Railroad Co., 1918		
Soil, yellow	15	15
Ogallala formation:		
Caliche	25	40
Clay and gravel	45	85
Quicksand	15	100
Clay, yellow	10	110
Clay and boulders	10	120
Clay, tough, yellow	10	130
Sand, fine	5	135
Sand, coarse and boulders	30	165
Quicksand	15	180
Sand, coarse (water)	10	190
Gravel	12	202
B3-46-4bd		
Soil	2	2
Ogallala formation:		
Clay, yellow	18	20
Rock, hard	4	24

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Yuma County--Continued

	Thickness (feet)	Depth (feet)
B3-46-4bd--Continued		
Ogallala formation--Con.		
Clay	20	44
Clay and gravel	20	64
Caliche	28	92
Gravel (water)	10	102
Gravel	39	141
B4-44-18db		
Soil	2	2
Ogallala formation:		
Sand	18	20
Caliche	15	35
Gravel	6	41
Rock	8	49
Sand and gravel	11	60
Clay	12	72
Rock	5	77
Clay	8	85
Gravel	25	110
B4-44-36cb. Drilled by L. L. Canfield, 1949		
Dune sand	11	11
Ogallala formation:		
Clay	2	13
Sand	5	18
Clay and sand	3	21
Sand	3	24
Clay	4	28
Sand	5	33
Clay	5	38
Sand and gravel, loose	6	44
Gravel and sand	10	54
Clay	1	55
Gravel, cemented	3	58
Clay	12	70
Clay, sand, and gravel, cemented	5	75
Gravel	3	78
Sand and gravel	3	81
Clay	3	84
Sand, dirty, loose	8	92
Sand, gravel, and clay	8	100

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Yuma County--Continued

	Thickness (feet)	Depth (feet)
B4-45-14cc		
Soil	2	2
Ogallala formation:		
Sand, white	20	22
Gumbo, black	5	27
Sand, white (water)	15	42
Shale, blue	10	52
Rock	20	72
Gravel	20	92
Gravel (water)	28	120
B4-46-5		
Ogallala formation:		
Sand	20	20
Clay, red	20	40
Gravel	40	80
Clay, red	40	120
Gravel	60	180
Gravel (water)	16	196
Clay	...	196
B5-43-24ab. Drilled by L. L. Canfield, 1949		
Dune sand	32	32
Ogallala formation:		
Sand, gravelly to coarse	5	37
Sand, fine-grained, cemented with calcium carbonate, containing solution cavities	20	57
Clay	27	84
(?)	3	87
Sand, coarse, containing pieces of calcium carbonate with embedded sand grains	6	93
Rock, calcareous, containing embedded sand grains	14	107
Clay, calcareous, containing grains of fine sand	10	117
Gravel; particles coated by calcium carbonate	8	125
Caliche, sandy	52	177
Gravel	7	184

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Yuma County--Continued

	Thickness (feet)	Depth (feet)
B5-43-24ab--Continued		
Ogallala formation--Con.		
Clay, brown, with stringer of caliche	13	197
Gravel	20	217
Caliche, sandy	7	224
Gravel	11	235
Clay, tan; contains fossil seeds	5	240
Gravel and sand, coarse	9	249
Gravel	11	260
B5-46-1		
Ogallala formation:		
Clay, red, and gravel	150	150
Clay, soft, red	50	200
Gravel, coarse	10	210
Clay	21	231
Gravel, coarse (water)	18	249
B5-48-12		
Loam, black	3	3
Ogallala formation:		
Hardpan and gravel	77	80
Gravel	80	160
Clay and gravel	103	263
Gravel, coarse (water)	3	266
C1-43-5cd		
Ogallala formation:		
Soil	160	160
Gravel	52	212
Clay and gravel	38	250
Pierre shale:		
Shale	10	260
C1-43-34bb		
Soil	3	3
Ogallala formation:		
Clay	15	18
Gravel	3	21
Pierre shale:		
Shale	1	22

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Yuma County--Continued

	Thickness (feet)	Depth (feet)
C2-44-24ba		
Soil	3	3
Ogallala formation:		
Caliche	10	13
Rock	15	28
Gravel	20	48
Clay	20	68
Rock	32	100
Gravel and sand	30	130
Rock	30	160
Pierre shale:		
Shale	20	180
C3-44-28. (South half)		
Soil	2	2
Ogallala formation:		
Clay and caliche	240	242
Gravel (water)	14	256
C4-44-5dd. Drilled by Ben Hasz, 1950		
Ogallala formation:		
(No samples)	224	224
Gravel, good	23	247
Clay	1	248
Gravel, good, containing small strips of clay	7	255
Clay, sandy, with some sand	18	273
Clay, containing strips of rock	12	285
Sand	2	287
Clay, containing strips of sand	7	294
Sandstone, interbedded with clay	8	302
Sand and gravel, loose	13	315
Clay, sandy	5	320
Sand, containing small strips of clay	12	332
Pierre shale(?):		
Shale	4	336
C4-44-10dd. Drilled by K. G. Wilcox, 1950		
Soil	4	4
Ogallala formation:		
Clay	52	56

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Yuma County--Continued

	Thickness (feet)	Depth (feet)
C4-44-10dd--Continued		
Ogallala formation--Con.		
Caliche, soft	20	76
Caliche, hard	10	86
Gravel	5	91
Clay	5	96
Clay and gravel	12	108
Gravel	4	112
Clay, sandy	14	126
Gravel	11	137
Caliche and clay	4	141
Caliche, hard	2	143
Caliche, hard, and clay	11	154
Caliche	2	156
Clay, sandy	2	158
Caliche, hard	1	159
Sandstone and clay	4	163
Gravel and strips of rock	5	168
Clay, sandy	2	170
Gravel	4	174
Clay and gravel	4	178
Gravel	6	184
Caliche	5	189
Gravel	5	194
Rock	2	196
Clay, sandy	2	198
Rock and hard caliche	6	204
Rock, very hard	9	213
Clay	3	216
Gravel, coarse, very loose	15	231
Sand and clay	5	236
Conglomerate and strips of clay	27	263
Conglomerate, hard	1	264
Clay	1	265
Sandstone	5	270
Clay, sandy	9	279
Gravel	3	282
Clay, sandy	4	286
Gravel	4	290
Clay, sandy	2	292
Gravel, loose, and strips of clay	19	311
Clay	2	313
Gravel, medium, loose	13	326
Clay	...	326

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Yuma County--Continued

	Thickness (feet)	Depth (feet)
C4-47-25dc. Drilled by L. L. Canfield, 1951		
Soil	5	5
Ogallala formation:		
Clay and sand	4	9
Caliche and clay	8	17
Gravel and sand	19	36
Caliche and gravel	9	45
Clay	10	55
Clay and gravel, solid	6	61
Clay and sandstone, thin	12	73
Caliche and sandstone	5	78
Clay	4	82
Clay and sandstone	14	96
Clay and sandstone; contains a little gravel	4	100
Clay and sandstone	2	102
Rock	3	105
Clay	1	106
Clay, thin sandstone, and gravel	6	112
Gravel and sand, solid	3	115
Clay, sandstone and gravel	3	118
Sandstone, solid	2	120
Gravel and sand	4	124
Sandstone, solid	3	127
Sandstone, soft, and clay	6	133
Sandstone, soft and hard, and clay	8	141
Clay, containing thin strips of soil and hard sandstone	16	157
Clay and sand	1	158
Clay and soft sandstone	14	172
Clay, sandstone, and sand, interbedded	10	182
Gravel and sand, loose and tight	15	197
Clay	4	201
Clay and dirty fine sand	3	204
Clay	5	209
Clay, containing thin strips of sand	7	216

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Yuma County--Continued

	Thickness (feet)	Depth (feet)
C4-47-25dc--Continued		
Ogallala formation--Con.		
Clay, sand, and gravel	4	220
Clay	5	225
Gravel, coarse, and fairly loose sand	16	241
Clay, containing thin strips of fine sand	14	255
Gravel, coarse, tight, and sand; contains a little clay	10	265
Shale, yellow	9	274
Shale, yellow to blue	13	287
Pierre shale:		
Shale, blue	1	288
C5-42-5. (East half)		
Soil	20	20
Ogallala formation:		
Rock	4	24
Clay, sandy	4	28
Sand (water)	4	32
Gravel (water)	6	38
Clay balls and gravel	9	47
Gravel (water)	4	51
Pierre shale(?):		
Shale	...	51
C5-44-23dd. Drilled by K. G. Wilcox, 1950		
Soil	5	5
Ogallala formation:		
Clay and gravel; contains soft rock	2	7
Clay, containing strips of gravel and rock	14	21
Clay and gravel	9	30
Gravel, coarse, very loose	11	41
Clay	1	42
Gravel, coarse, very loose	5	47
Sand and gravel, loose; contains strips of clay	5	52
Gravel, very loose, contains strips of clay	23	75

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Yuma County--Continued

	Thickness (feet)	Depth (feet)
C5-44-23dd--Continued		
Pierre shale:		
Shale, yellow	5	80
Shale, blue	5	85
C5-44-30bb. Drilled by K. G. Wilcox, 1948		
Clay	21	21
Ogallala formation:		
Gravel	10	31
Caliche	6	37
Clay	6	43
Gravel, coarse	10.5	53.5
Caliche, soft	4.5	58
Clay	2	60
Gravel	3	63
Sandstone	1	64
Gravel	21	85
Pierre shale(?):		
Shale	...	85
C5-47-4ba. Drilled by Mr. Skidmore, 1949		
Soil	10	10
Ogallala formation:		
Caliche	4	14
Gravel, clay, and strips of soft sandstone	92	106
Gravel	12	118
Gravel and sandstone	43	161
Gravel	12	173
Pierre shale:		
Shale, clayey, blue	3	176

Table 2.--Logs of test holes, seismograph shot holes, and wells--Continued

Yuma County--Continued

	Thickness (feet)	Depth (feet)
C5-47-16ad. Drilled by K. G. Wilcox, 1949		
Soil	3	3
Ogallala formation:		
Clay, yellow	15	18
Clay	5	23
Gravel	13	36
Clay	7	43
Caliche	14	57
Sandstone, soft	5	62
Conglomerate	2	64
Sand and gravel	13	77
Sandstone	6	83
Sand, containing strips of rock	4	87
Sandstone	7	94
Sand and gravel	13	107
Gravel	7	114
Clay, sandy	3	117
Gravel	12	129
Joint clay	28	157
Clay	3	160
Sand, fine, containing strips of clay and rock	8	168
Clay, sandy	1	169
Sandstone	1	170
Sand, fine, containing strips of sandy clay	7	177
Clay, sandy	7	184
Sand and gravel, loose	14	198
Clay, sandy, and gravel	1	199
Sand and gravel, loose	15	214
Clay	1	215

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